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31ST Annual
Undergraduate Research, Scholarship and Creative Activities Conference

Posters, Orals, and Arts & Design Exhibit
May 7-8, 2020

UCDAVIS
Undergraduate Research Center
Office of Undergraduate Education

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31st Annual Undergraduate Research, Scholarship and Creative Activities Conference

Letter from the Chancellor

May 7, 2020

Dear Students, Colleagues and Guests:

On behalf of UC Davis, it's my pleasure to welcome you to the 31st Annual Undergraduate Research, Scholarship and Creative Activities Conference!

UC Davis is one of the top research universities in the nation, with globally leading programs in agriculture, veterinary medicine, environmental science, healthcare and more. Our scholarship and research addresses some of society's most critical challenges, including climate change, feeding the world and sustaining the health of all living beings.

Student researchers are at the heart of the research enterprise. They represent a wide variety of fields and are critical to building a better tomorrow.

Through this conference, we are preparing our students to move into the future with confidence and creativity. We are providing and showcasing educational opportunities that prepare students for career success. Many employers are looking for talented people who not only shine in their research and scholarship, but also have the capacity to collaborate and communicate their work in the most impactful manner possible. In addition to the skills developed during research, these oral and poster presentations are a great form of practice as our students prepare for graduate school and the workforce.

Our students are currently facing an environment like no other, amid a pandemic that has changed every facet of daily life. Yet they still maintain their passion for their research and desire to participate in a virtual conference. Our students continue to demonstrate their ability to problem solve and adapt to any situation.

I congratulate the student presenters for their dedication and excellent work thus far. They have partnered with faculty mentors and peers in a spirit of collaboration and discovery. Now, they can share their work with experts in their fields and our UC Davis community.

I want to thank the Undergraduate Research Center for organizing this important conference and connecting students with important research opportunities, programs and awards. I also want to recognize our faculty members, who serve as mentors and role models for students. Your collaboration and mentorship with students brings out the very best in UC Davis, and your work helps prepare them for future success. Finally, I extend my gratitude to the many faculty volunteers and staff who serve as moderators for the conference sessions. This is exactly the kind of thoughtfulness and synergy between students and faculty that defines UC Davis.

I wish everyone a great conference and thank you for bringing out the best in our university.

Gary S. May
Chancellor

ACKNOWLEDGMENTS

The Undergraduate Research, Scholarship & Creative Activities Conference gratefully acknowledges the faculty sponsors and other individuals whose mentoring has contributed to the research produced by our presenters. We would also like to thank the many programs that generously support and encourage undergraduate research and creative activities at UC Davis. Among these are the following: Beckman Scholars Program; California Alliance for Minority Participation (CAMP); Educational Enrichment Outreach Programs (BUSP, BUSP-Honors, BSHARP-MARC, CURE, ADAR); Innovation Institute for Food & Health Undergraduate Research (IIFH), Internship and Career Center; McNair Scholars Program; Mentor-Mentee Program in Humanities, Arts, Cultural Studies and Social Sciences; Mentorships for Undergraduate Research in Agriculture, Letters and Science (MURALS); Mentorships for Undergraduate Research Participants in the Physical and Mathematical Sciences (MURPPS); Provost's Undergraduate Fellowship; University Honors Program; UC Davis Washington Program; UC Leadership Excellence Through Advanced Degrees (UC LEADS), and Vertically Integrated Projects (VIP).

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ABSTRACTS

Enzymatic Function of Succinate Dehydrogenase from V. *radiata* Mitochondria

Kaitlyn Abe
Sponsor: James Letts, Ph.D.
Molecular & Cellular Bio

Plant respiration is an essential metabolic process, like photosynthesis. However, unlike photosynthesis, little is known about plants' respiratory complexes and the detailed mechanisms by which they produce energy. Succinate dehydrogenase, also known as respiratory Complex II (CII), plays central roles in plant respiration and physiology and is often the target of herbicides. In addition to four conserved subunits, CII contains four plant-specific subunits. In order to understand plant respiration, it is critical to understand the roles of these plant-specific subunits and molecular mechanism of the enzyme. I adapted and optimized a protocol from classic plant literature to measure the enzymatic activity of CII in purified mitochondrial membranes from mung beans. From these assays, I derived the CII's turnover rate and Km and discovered inhibitor constants that had previously not been described. Results from these assays will allow for a better characterization of CII and will help to interpret the enzymatic structure and roles of each subunit.

Manipulating Human Intestinal Epithelium Cell Surface N-glycans Influences Salmonella Infection

Kavya Achyutuni
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

Microbe-host interactions are mediated by protein-carbohydrate binding processes. The adherence of pathogenic bacteria to cellular targets in mammalian tissues is important for virulence. Salmonella enterica serovar Typhi (S. Typhi) is a bacterium that infects the blood and intestinal tract and causes typhoid claiming the lives of 200,000 people annually. Glycosylated intestinal epithelium cells are the first barrier in the mammalian system that bacteria infiltrate. However, limited methods to comprehensively explore the roles of host glycans involved in bacterial infection exist. We established a cell-based model to perform reliable structure-phenotype correlative experiments and compare the effect of individual N-glycan types in bacterial infection. We treated the human colon cancer cell line, HCT116, with various proximity labelling methods. The cells were harvested and the cell membrane was enriched using ultracentrifugation. The cell surface N-glycans were released using PNGase F, and the resulting N-glycans were purified using porous graphitic carbon (PGC) and analyzed via nanoLC chip-Q-ToF MS/MS. Meanwhile, robust assays for bacterial adhesion on host cells and their invasion were used to evaluate Salmonella infection capacity. Understanding the role host glycans during bacterial infection can allow us to develop cutting edge methods to prevent bacterial infection and design new drugs to combat diseases.

Unsymmetrical Bipyridine Coordination in $[(R_3P)Au(bipy)]XF_6$ Complexes

Alexandria Adams
Sponsor: Alan Balch, Ph.D.
Chemistry

Based on a known synthesis and crystal structure of a 2,2'-bipyridyltriphenylphoshinegold(I) hexafluorophosphate complex ($[(Ph_3P)Au(bipy)]PF_6$), apparent unsymmetrical bond lengths between Au(I)-N in the bipyridine to gold(I) coordination were investigated. Similar gold(I) bipyridine complexes were synthesized to confirm if the unsymmetrical bond lengths would reoccur in similar complexes. Triphenylphosphine (Ph_3P) and triethylphosphine (Et_3P) were used as ligands and hexafluorophosphate (PF_6^-), hexafluoroarsenate (AsF_6^-), and hexafluoroantimonate (SbF_6^-) were used as anions to synthesize five new complexes. The $[(Ph_3P)Au(bipy)]^+$ crystals are isostructural to each other; separately, the $[(Et_3P)Au(bipy)]^+$ crystals are isostructural to each other. The bipyridine ligands coordinate to the gold(I) in an unsymmetrical fashion in all the complexes in their crystalline form. The unsymmetrical bonds between Au and N decrease going from P to As to Sb in the anion, for Ph_3P and Et_3P. Distance differences ranged from 0.241(2) to 0.146(2) Å. In comparison to Ph_3P, Et_3P complexes display more unsymmetrical bipyridine coordination to gold(I). The complexes show no sign of luminescent properties, in comparison to other known gold(I) phosphine complexes, and further investigation was done with multiple collaborations to understand why the unsymmetrical coordination, an unusual condition for bipyridine complexes, is favorable.

Cytokines as a Measure of Maternal Inflammation: A Link to Alterations in Offspring Neurodevelopment

Sarah Adams
Sponsor: Melissa Bauman, Ph.D.
MED: Psychiatry & Behav Sci

Women exposed to viral or bacterial infections during pregnancy are at a greater risk of having children with neurodevelopmental disorders such as autism. The rat MIA (Maternal Immune Activation) model was employed to further investigate the connection between the maternal cytokine response and alterations in offspring neurodevelopment. Poly I:C, our immunostimulant of choice, was used to mimic prenatal infection. On the morning of gestational day (GD) 15, pregnant dams underwent a blood draw followed immediately by injection with either saline or different doses of low (0.2-1 kb) molecular weight Poly I:C or high (1.5-8 kb) molecular weight Poly I:C. Another blood draw was performed four hours later to measure changes in the dams' immune responses by measuring cytokine levels. The levels of serum cytokines IL-1ß, IL1-a, IL-2, IL-4, IL-5, IL-6, IL-10, IL-12, IL-13, IL-17, GM-CSF, IFN-γ, and TNFa were determined using rat multiplexing bead immunoassays (Bio-Rad Laboratories, Hercules, CA). Cytokines act as cellular signals for inflammation that may contribute to potential neurodevelopmental changes in offspring. Studying how cytokine levels change as a result of different doses and forms of immunostimulants will further our understanding of how prenatal infections can result in offspring with alterations in neurodevelopment.

Effects of Increasing Iron Doses on Systemic Iron Regulation

Haley Adel
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Infants who are not breast-fed receive iron through enriched formulas or supplements. However, there is concern about adverse effects (decreased growth, increased infections) in infants already having adequate iron status. Therefore, we decided to investigate growth following increasing daily iron supplementation doses in suckling rats. We supplemented treatment litters (10mg, 30mg, or 90mg ferrous sulfate/kg body weight) or vehicle control (10% sucrose) daily beginning postnatal day (PD) 2 until PD10. On PD10, growth was significantly lower in the Fe-90 group compared to control ($p<0.02$). We then investigated iron regulation and growth by measuring the proteins duodenal ferroportin, which transports iron from the duodenum to the systemic circulation, and hepcidin, which disintegrates ferroportin. As we analyzed hepcidin expression using RNA extraction and duodenal ferritin heavy chain protein using Western blots, we found that both were significantly higher in the treatment groups [($p<0.0001$) and ($p=0.0005$), respectively.] However, there was no significant difference in duodenal ferroportin protein ($p=0.4519$). While studies on adult iron regulation have shown that liver hepcidin increases with elevated iron stores and inflammation, these results indicate that excess iron may have negative consequences on infant development, and suggests that iron regulation in newborns/early life is not fully understood.

Investigating Transcranial Electric Stimulation on Rodent Brains through Computer Modeling

Muhammad Afaq
Sponsor: Min Zhao, Ph.D.
MED: Dermatology

Transcranial Electrical Stimulation (TES) is a form of neuromodulation in which currents are induced into the brain using various techniques. This area serves a variety of applications including stimulation of Alzheimer's Beta-Amyloid proteins in the Hippocampus to promote neurogenesis. The purpose of this study is to form a more solid understanding of how the electric current is distributed throughout the brain. In this experiment, stimulation in mice and rat brains is going to be investigated. This is achieved by running computer simulations on 3 dimensional C57BL/6 mouse brain composing of 39 different segments and Sprague Dawley rat brain consisting of 118 segments. These two atlases were generated from MRI and Nissl histology. Moreover, electrical conductivity and mass density is applied to those segments. Two electrodes are placed on the frontal cerebral cortex on each hemisphere. These simulations will be generated by a software called SIM4LIFE by Zurich Med Tech Ag. Lastly, the results of these simulations are presented in the form of 3D contour graphs and images for analysis. In conclusion, we have estimated how currents are distributed deep in the brain. Furthermore, this will help in understanding how TES therapy affects Alzheimer's brain and other pathological conditions.

Time to Arterial Testing Affects Outcomes for Patients with Lower Extremity Wounds

Angela Aguirre
Sponsor: Misty Humphries, M.D.
MED: Surgery

Patients with critical limb ischemia and concurrent wounds suffer higher rates of amputation. An ankle brachial index (ABI) is the standard practice for screening peripheral artery disease in patients. Our study goal was to determine if high risk patients who received an earlier ABI were less likely to receive an amputation later in life. Patients with lower extremity wounds from diabetes mellitus or peripheral artery disease have a risk of amputation as high as 25%. In patients with arterial disease, revascularization decreases the risk of amputation. We aimed to determine if early assessment of arterial perfusion correlates with amputation rates. We retrospectively reviewed patients referred to the vascular clinic over an 18 months with lower extremity wounds to determine when and who performed a complete pulse exam, and when diagnostic studies to evaluate perfusion were performed. Kaplan Meier analysis was used to determine if timing affected outcomes for treatment an amputation. Early ABI testing expedites specialty referral and time to revascularization. It can decrease time to wound healing. Larger cohort studies are needed to determine the overall effect of early ABI testing to decrease amputation rates.

The Influence of ECM Structure on Myoblast Proliferation and Differentiation

Sarah Ahmad
Sponsor: Lucas Smith, Ph.D.
MED: Physical Medicine & Rehab

Extracellular Matrix (ECM) has been proven to influence cell proliferation and differentiation. Collagen is the major component of ECM and the experiments conducted were to evaluate how collagen architecture affects myoblast proliferation and differentiation. This is important in fibrotic muscle diseases where ECM structure is altered. The C2C12 myoblast line was used to evaluate the architectural features of collagen concentration, cross-linking, alignment, and fibril diameter. These features were manipulated by controlling the quantity of collagen, the proportion of non-crosslinkable collagen, magnetic beads to align collagen, and polymerization temperature respectively. Using an Edu assay to assess myoblast proliferation we found that Matrigel, thinner fibril diameter, randomly aligned gels, and a concentration of 3 mg/ml led to significantly increased proliferation while cross-linkage, aligned gels, and a concentration above and below 3mg/ml did not alter proliferation. Using Immunolabeling to quantify myoblast differentiation index we found that a thinner fibril diameter and a collagen concentration of 3-4.5 mg.ml led to significantly increased differentiation. In conclusion, manipulating different factors of collagen structure can impact cell proliferation and differentiation which is important for therapies to counteract fibrotic muscle diseases.

The Role of bHLH032 in Tomato Leaf Shape and Fruit Production

Ye Jin Ahn
Sponsor: Neelima Sinha, Ph.D.
Plant Biology

Introgression lines from a cross between the cultivated tomato Solanum lycopersicum cv M82 and a wild relative, Solanum pennellii, have genes mostly from M82 but contain small pieces of DNA from S. pennellii. One introgression line, BIL 260, showed significantly increased yield and fruit sugars (BRIX) than M82. It is likely that the introgressed region of S. pennellii influences yield and BRIX in BIL 260. One of the genes originating from S. pennellii in BIL260 is a bHLH transcription factor. We generated CRISPR lines mutated in the second exon of bHLH032 in M82 and quantified their phenotypes and genotypes. These lines had rounder leaves and lower leaf vasculature density like BIL260, which has been shown to improve yield and fruit BRIX (Rowland et al., 2019). However, they had varying yield and BRIX due to different mutations. Mutant lines with an early stop codon showed low yield and floral defects as bHLH032 expression was knocked out, suggesting its expression is also important for floral development. Other mutant lines that had a later stop codon showed similar or improved yield than M82. I will study how the level of bHLH032 expression differs in the mutant lines and influences fruit production in tomato.

Attitudes and Perspectives in Understanding Type 2 Diabetes: Patients Versus Care Providers

Olutola Akande
Sponsor: Monica Torreiro-Casal, Ph.D.
Chicano Studies

There are numerous strategies in the management of type 2 diabetes mellitus, and studies have shown that lifestyle changes and diabetic drugs can reduce the incidence and burden of the disease. Yet, type 2 diabetes is the 7th leading cause of death in the United States. Studies have shown that despite the many available evidence-based guidance, many patients with type 2 diabetes fail to meet treatment goals. Negligence or poor adherence to treatment therapies is often cited as the reason behind the poor treatment outcomes related to type 2 diabetes. Although the existence of a significant gap between the understanding of the physician and patient in the prognosis and treatment of the disease is not novel, research and suggested interventions often fail to match the degree of significance of the problem. Fewer studies have focused on the comparison between physician perception and that of minority patients. The aim of this study is to use qualitative methods to articulate the reference frames with which care providers and minority patients understand type 2 diabetes and its treatment, and to propose strategies and interventions through which the divide in perspectives can be bridged to facilitate better patient outcomes.

Iranian-American Immigrant Youth and Identity Construction Through Cultural Consumption

Kimia Akbari
Sponsor: Amy Motlagh, Ph.D.
Comparative Literature

The complexity of identity construction is perhaps most deeply experienced by immigrant youth whose most formative years are interrupted by the transition into the diaspora. Few bodies of research address how identity construction in young adulthood is manifested for Iranian-Americans who immigrated to the US in their teenage years. For the generation who immigrated in the past decade, heightened mobility between Iran and the U.S. raises new questions. Whereas previous waves of Iranian immigrants following the 1979 revolution had limited ability to return, the mobility of the current generation and the access provided by social media, has dramatically increased access to both tangible and intangible Iranian cultural products. Thus, Iranian-American young adults can consume cultural products such as music, media, and accessories in order to heighten and perform their experience of “Iranian” identity. This study asks if these claims to an Iranian authenticity help youth reconcile feelings of alienation during their immigration and assimilation experience. Cultural consumption may help produce facets of the “self” and assist in constructing the narrative of their identity. This study posits that to resist being culturally and ethnically “othered,” these young immigrants reclaim “otherness” through specific performances of Iranian cultural identity and cultural consumption.

Investigating Retrograde Signaling from the Olfactory Bulb to the Olfactory Mucosa in Acute Amyloid-beta Induced Neuroinflammation

Abdullah Al Tekreeti
Sponsor: Qizhi Gong, Ph.D.
MED: Cell Biology & Human Anat

Early detection of neuroinflammation in the brain is challenging due to the lack of reliable and accessible biomarkers. The olfactory nerve is a short cranial nerve that bypasses the blood-brain barrier, directly connecting the external environment to the brain. Neuronal communication can be achieved both anterogradely and retrogradely. We hypothesize that retrograde signaling could convey olfactory bulb inflammation through the olfactory nerve to the olfactory epithelium. Amyloid-beta is a byproduct of neural signaling that can accumulate with age, causing inflammation and, later, inducing Alzheimer’s disease. We introduced A-ß into the OB by stereotaxic injection to induce acute neuroinflammation. Tissue samples were collected at different times post-injection (PI) for gene expression evaluation and immunocytochemistry. We observed significant upregulation of IL-1ß and CXCL10 expression in the OB, and IL-6 and TNF-a in OE 24hrs PI. This suggests that OE gene expression changes reflect neuroinflammation in the OB, which makes it a possible site for A-ß plaque detection. Immunohistochemistry is underway to determine the cell-type specific expression of the upregulated cytokines.

An Analysis of the Term "Kurd" in the New York Times (1900-1909)

Christopher Alam
Sponsor: Suad Joseph, Ph.D.
Anthropology

Through in-depth qualitative analysis of The New York Times articles from 1900-1909 that mention the term "Kurd," the question I put forth is how the image of the Kurds in the Ottoman Empire shifts relative to the increased aggression towards Armenians. Most research points to the Sultan's need for internal and border security and the Hamidye's effectiveness as the reason for the Kurd's increased status in the Empire. What is missing in other explanations is how the Armenians and Kurds were in similar circumstances prior to the Hamidye's formation- both fighting for autonomy from the Ottomans- and the role that the faiths of the two groups played in the outcome. I argue that the Kurds were preferred over the Armenians by the Sultan in large part due to their Muslim faith, whereas the Armenians are Christians. This is a better answer as it considers the Pan-Islamism ideals that were a defining factor of Abdul Hamid II's policies. This is an important question to answer because it will help to explain the reasons and events leading up to the Armenian Genocide, one of the worst massacres in history.

Environmental and Performance Testing of Hard Disk Drives as Low-Cost CubeSat Reaction Wheels

Brandon Alba
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Hard Disk Drive (HDD) tech demonstration of the ADCS for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Commercial CubeSat reaction wheels cost on the order of 10^4 to 10^5 USD. REALOP will repurpose 30 USD hard disk drives, typically found in laptops and iPods, as a low-cost alternative to commercial reaction wheels. Mass-manufacturing of HDDs to high precision standards make them a very reliable and accessible technology. A highly configurable, low cost ESC IC was adapted to control and report the speed of HDD motor for precision attitude control. Appropriate mass and speed properties indicate that HDDs can meet the control requirements of the 2U REALOP CubeSat. Environmental testing is performed on multiple popular and readily-available models of HDDs to verify which can, or cannot, withstand launch and orbit conditions. Performance testing is conducted on an air-bearing testbed to characterize the HDDs and demonstrate that they meet mission pointing and stabilization requirements. Successful integration and on-orbit testing can further prove the utility of HDDs as reaction wheels for low-budget small satellite missions.

First-Generation and Working-Class Latino/a/x Student Experiences with Faculty and Mentorship at the University of California, Davis

Belen Alcantar
Sponsor: Monica Torreiro-Casal, Ph.D.
Chicano Studies

Higher education institutions are modeled after the upper and middle classes that reinforce their ideology into education. Expectations from these institutions are shaped and influenced by beliefs held by individuals from "affluent" backgrounds. Those from a working-class background are at a disadvantage when they enter large universities. Considering that Latina/o/x students make-up a large portion of the working-class, along with being largely a first-generation group, how they navigate large institutions is crucial to understand. It is known that academic services and mentorship/guidance does help improve student experiences. This preliminary study serves to explore the narratives of Latino/a/x students navigating a large research institution in terms of faculty. Latino/a/x students were interviewed to understand their stories about their interactions and mentor relationships with faculty and other authority figures at UC Davis. Since Latina/o/x individuals account for about 25% in higher education institutions, including at UC Davis, it is crucial to understand how this population is navigating higher education since these realities can help institutions better adapt and serve students with these intersecting identities. UC Davis being on track to be a Hispanic Serving Institution reflects the immediate need to hear the voices of its students in order to better serve them.

Intrinsic (but not Extrinsic) Religiosity Predicts Positive Psychological Outcomes After Romantic Breakups

Alexa Alcser
Sponsor: Paul Eastwick, Ph.D.
Psychology

A large body of research has demonstrated that religiosity can help individuals cope with significant life stressors. However, there is a deficit of empirical evidence exploring the connection between religiosity and coping with romantic breakups (e.g., divorce). Moreover, there is virtually no research examining early life relationships (e.g., dating). In the present research, we recruited undergraduate participants who had experienced a romantic breakup in the past 6 months and collected data from them via an at-home survey and an in-lab study. In particular, we asked about their religious beliefs and assessed several aspects of their romantic breakup. We found that their internalized religious beliefs (the importance of their faith in day-to-day life) were associated with feeling closer to their ex-partners and more supported by others, whereas their external religious behaviors (attending religious services) were not. Implications for the ways in which religion impacts well-being and relationship health will be discussed.

Intergenerational Transmission of Caring and Sensitive Parenting in Mexican American Families

Esmeralda Aldana
Sponsor: Leah Hibel, Ph.D.
Human Ecology

Past research on intergenerational parenting looks at how different parenting styles affect the upbringing of their own children. This current study examines the association between a parent's own early childhood and adolescent experiences care and over protection to their current parenting behaviors and parent-child interactions. The data were collected during home visits with 75 Mexican origin mothers living in Sacramento and Woodland as part of the California Babies Project. During these visits, 29 mothers with their 6 and 18 month children voluntarily participated in a video activity where mother-infant interactions during playtime were recorded. These videos were coded using qualitative rating scales based on the National Institute of Child Health and Human Development (NICHD) coding guidelines for recorded mother-infant interactions. More data is being collected and will be coded by the time of the Undergraduate Research Conference. We are using the Parental Bonding index to measure the parents own childhood experiences. We hypothesize that parents who experienced more care and overprotection will be higher in positive affect, sensitivity, and less detached while parents who experienced less care and overprotection will score higher in negative affect, detachment, and less sensitivity.

Identifying and Reconstructing Repetitive Element Arrays in the Human Genome

Abdulelah Alharbi
Sponsor: Kiho Cho, D.V.M.,Ph.D.
MED: Surgery

The human genome consists of ~2% conventional genes but a vast majority of the rest are repetitive elements (REs). These REs are occasionally clustered in larger groups of tandem repeats, called repetitive element arrays (RE arrays). While examining the genomic landscape of cerebral palsy patients, we unexpectedly identified and cataloged multiple RE arrays. While some of the arrays were close to perfect tandem repeats, others were “broken”, i.e., contained many point mutations, insertions, and deletions. We devised a method to correct these broken arrays in order to determine a possible original RE array sequence. From a group of 64 arrays, 3 reconstructed RE arrays of interest were then re-BLASTed on the human genome to identify their respective RE array families. These RE array families were composed of a range of 30-60 members. Some RE arrays, due to their genomic location and/or highly-ordered structure, may play a role in determining phenotype. Understanding the evolution, diversity, and function of RE arrays may provide important insight into genomic function.

Infants Use Prior Listening Experience to Support Word Learning

Mariam Ali
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

We investigated how infants take advantage of their early language listening experience to learn new words. We examined whether hearing speech sound sequences in an unfamiliar language helps infants learn new object names. Seventeen-month-old infants heard an artificial language made of four novel words for three minutes (e.g. golatu, tibudo, daropi, pabiku). One group (n = 22) saw two novel objects paired with two words from the artificial language (e.g. tibudo and pabiku) and another group (n = 22) heard labels that maintained the first and last syllables, but the middle syllable was replaced with the middle syllable of a different word (e.g. pabiku vs paroku). We hypothesized that when infants store detailed representations of words after listening to a stream of speech, they are more efficient at forming a mental connection between specific words and objects compared to infants without prior exposure. In contrast, infants who hear the changed labels do not have that support from the speech stream and will have difficulties learning new labels. Our results support statistical learning accounts of language acquisition that propose infants use prior listening experience with regularities in speech sound sequences to stimulate vocabulary learning.

Can Persuasive Memes Get People to Exercise? Stereotype Threat and Lift Effects on Physical Activity

Camren Allen
Sponsor: Jorge Pena, Ph.D.
Communication

This study tested how raising the salience of stereotypes about men and women’s physical prowess through memes can influence physical activity. Participants were randomly assigned to one of three meme exposure conditions (stereotype threat, stereotype lift, control) and then asked to perform a running task for ten minutes while onscreen motion-capturing avatars displayed the participant’s face. Physical activity was measured with accelerometers and a heart rate monitor. Based on stereotype threat effects, we expect that exposing participants to a meme that threatens confidence in their physical abilities may decrease their cardiac frequency and step count relative to the remaining conditions. These effects may be linked to the concept of “stereotype lift” and “stereotype threat” in the context of exercise-related video games (Li & Lwin, 2015). The data was collected in fall 2019 and preliminary results will be discussed. The findings may illuminate how new technologies may be harnessed to incentivize health-related outcomes.

Nutrition Education for University Student Triathletes May Improve Nutrition Knowledge

Alyssa Allen
Sponsor: Rachel Scherr, Ph.D.
Nutrition

While the UC Davis Triathlon Team has comprehensive information about the physical aspects of training, there is minimal information regarding nutrition. This nutrition education program aims to increase the nutrition knowledge of the athletes on the team. Based on a review of the literature, a presentation and a brochure deliverable encompassing a range of sports nutrition information was created and presented, covering topics such as how to ensure adequate nutrition for workouts and races. Analysis of the responses generated from a standardized questionnaire was completed to understand the amount of information gained by participants. The results indicated that the presentation yielded increased nutrition knowledge in UC Davis Triathlon student-athletes. Based on these results, this type of program could be implemented for other club sports teams both within or outside of UC Davis to increase nutrition knowledge. Further research is needed to identify other factors that could strengthen the effectiveness of the program.

Identification of a Signaling Hub in the N-terminus of the MutS Homolog, Msh4

Lilly Alocozy
Sponsor: Neil Hunter, Ph.D.
Microbiology & Molec Genetics

Meiosis is a special cell division that results in gametes. In order to promote genetic variation in daughter cells, crossing over can occur during meiosis. Crossing over is the when non-sister chromatids of homologous chromosomes exchange genetic material with each other to create recombinant chromatids. This process is essential for the faithful disjunction of homologous chromosomes during the first meiotic division. Not only is crossing over significant for the normal segregation of chromosomes but also its frequency contributes to the mapping of chromosomes. Regulatory processes that control crossing over remain poorly characterized. Our lab studies regulation of recombination factors including MutSg (a complex of Msh4 and Msh5), which is thought to function exclusively in meiosis, where it binds and stabilizes recombination intermediates. Here we identify a key regulatory domain in the N terminus of Msh4. We show that recombination-dependent phosphorylation of this domain stabilizes Msh4 protein and promotes crossing over during meiosis.

Structural and Functional Analysis of Mutant ß-Glucosidase B Variants from *Paenibacillus polymyxa*: G153A, E406Q, and D121F

Tara Allison
Sponsor: Justin Siegel, Ph.D.
MED: Biochem & Molecular Med

Computational enzyme modeling programs are versatile tools for prediction of kinetic parameters and thermal stability of various protein structural modifications. However, these can still benefit from further optimization in regards to prediction accuracy. This study analyzes the effects of amino acid substitutions throughout the structure of the enzyme ß-glucosidase B (BglB), a ß-D-glucoside metabolizing catalyst, from the bacteria Paenibacillus polymyxa. Three new variants are studied (G153A, E406Q, and D121F) and will be added to the project's existing dataset. The final forms of these independent mutations are variations of BglB that are either catalytically superior, inferior, or similar to the wild type BglB enzyme. This data contributes to a collection of mutations that drive and refine our program's enzyme modeling algorithm. This study utilizes cell transformations and cell culturing, protein purification via immobilized metal ion chromatography, protein yield titer measurements via spectroscopy, and determination of protein purity through SDS-gel electrophoresis. Kinetic and thermal stability measurements are collected through colorimetric and fluorescence-based assays as well. Ultimately, these continued mutational data studies could produce a highly accurate program that can predict structure-function relationships in the enzyme BglB. Such a tool may identify novel, catalytically improved enzyme variants for application in biomedical settings.

Deep State: From Periphery to Prominence in the Twentieth and Twenty-First Century

Jennifer Alpers
Sponsor: Kathryn Olmsted, Ph.D.
History

In 2016, Donald Trump claimed the American government was being run by a subversive group whose goal was to undermine the will of the American people and presented himself as the only person able to defend democracy. By 2017, President Trump began referring to these conspirators as the "Deep State." Although "Deep State" is a recent term, the notion that unelected officials are influencing policy is not. Employing essays, novels, and writings of the white power movement, this paper examines the origins of "Deep State" ideologies as found in twentieth-century white power conspiracy theories. Beginning in the 1970's with the unification of white power organizations, those involved claimed the government was run by an evil cabal. This cabal consisted of Jews who held sole power over the government. They referred to this state-within-a-state as the Zionist Occupation Government (ZOG). In the 1980's, leaders within the white power movement rebranded the unpalatable ZOG as the New World Order. This more acceptable term was quickly co-opted by mainstream evangelical leaders and soon found its way into the American zeitgeist. Ultimately this paper aims to prove that current "Deep State" conspiracy theories are little more than an updated New World Order ideology.

Positivity Bias in Verbal Episodic Memory for Native versus Non-Native Speakers

Priscilla Alvarado
Sponsor: Beth Ober, Ph.D.
Human Ecology

In prior experiments, our lab investigated potential differences in positivity bias for young-adult native English speakers (E1) vs. non-native speakers (E2). Across three verbal learning and memory experiments, we have obtained a significant language-related positivity effect (i.e., language x valence interaction), due to E2 speakers showing greater memory advantage for positive versus negative English words. In prior studies, each subject was given one long, mixed list of positive and negative words, from several semantic categories. The main purpose of the current study was to determine whether our language-related positivity effect would be replicated with a different type of list-learning paradigm, involving the learning of associations between meaningless symbols and five-word lists. Each "mini-list" was either positive, negative, or neutral, and contained either category co-members or unrelated words. Using this paradigm, we specifically aim to assess E1-E2 differences in: (a) positive versus neutral, as well as negative versus neutral, word recall; (b) modulation of valence effects by categorized versus unrelated word lists; and (c) valence versus category clustering for the overall, delayed, free recall trial. Data collection is ongoing; our poster will showcase preliminary findings.

The Role of TRPV1 in Regulating Neuroimmune Responses to Infection with a Bacterial Pathogen

Ramon Alvarez
Sponsor: Melanie Gareau, Ph.D.
VM: Anat Physio & Cell Biology

Increasing evidence suggests that there is a functional association between neuronal communication and immune responses. Citrobacter rodentium is a self-limiting enteropathogen that attaches to the colonic epithelial cells of the host, effacing the microvilli of the brush border creating attaching/effacing (A/E) lesions, triggering host immune response. C. rodentium in mice shares many similarities in pathogenicity with the human pathogens enteropathogenic Escherichia coli (EPEC) and enterohaemorrhagic E. coli (EHEC). C. rodentium infection results in elongation of colonic crypts as the host response to eliminate the pathogen. The transient receptor potential cation channel subfamily V member 1 (TrpV1) serves as a molecular integrator for sensory inputs to pain and inflammation. We therefore hypothesized that deletion of TRPV1 would impair the host response to C. rodentium infection. H&E staining and brightfield microscopy will be performed to assess colonic crypt length in response to C. rodentium infection in WT mice and in TRPV1$^{-/-}$ mice. The extent of immune response will be measured through crypt length at both 10 days post-infection (maximum response) and 29 days post-infection (pathogen clearance). We anticipate TRPV1 knockout mice will have an impaired immune response to C. rodentium infection leading to increased crypt length versus WT mice.

Rechargeable and Self-Cleaning Composite Materials For Improved Food Safety

Lucinda Amador
Sponsor: Gang Sun, Ph.D.
Biological & Ag Engineering

Food spoilage and foodborne diseases are caused by pathogenic contaminations during processing or packaging, and one of potential sources is transfer from food-contact devices to food surfaces. A current strategy being implemented is the direct application of chlorine bleach to sanitize food-contact devices and reduce food contaminations. This common bleach treatment however has limitations. It is effective to clean the surfaces at the sanitization process, but the surfaces of the devices will be soon contaminated by microbes during use. Thus, development of self-cleaning materials as the food contact materials is important. We reported a scalable method in creating a laminated N-halamine composite material consisting of halamine chemically bonded to a reinforcing cotton fabric component and a halamine polymer coating. This N-halamine composite material exhibits a great rechargeable biocidal function with characteristics and integrated properties of superhydrophilicity, a rechargeable chlorination capability (>600ppm), high antimicrobial efficiency (5 log reduction within 10-min contact), as well as robust mechanical long-term stability properties. There is strong potential for this composite material to be applied throughout the food industry as a food-contact material to prevent potential microbial transmissions.

PG&E and Wildfires: Investigating Wildfire Seasonality and Risk Internalization

George Anagnostou
Sponsor: Jeffrey Williams, Ph.D.
Ag & Resource Economics

The end of the 2010s was a tumultuous time for PG&E. In only two years, the company went from their all-time high stock price to an all-time low and chapter 11 bankruptcy. This collapse in the stock price and the current bankruptcy process are a direct result of the wildfires of 2017 and 2018. California has had wildfires in the past, and PG&E has a history with disasters, yet none of them in the last decade have caused such a severe plunge in the stock price. Were these wildfires surprises to PG&E and its shareholders? This paper seeks to answer this question. To do this, I investigate the seasonality of wildfire risk with utilities, namely PG&E and its comparables, to see if there are seasonal patterns in the company's stock price as influenced by the anticipation of wildfires. Additionally, I also examine the internalization of this wildfire risk into the stock price, and how much wildfires are "priced in."

Structure-Function Analysis of Rib72A and Rib72B in Motile Cilia

Lauren Anderson
Sponsor: Mark Winey, Ph.D.
College Bio Sci Deans Office

Rib72A and Rib72B have been identified as microtubule inner proteins (MIPs) that play a key role in the structural stability of motile cilia and are homologues of human EFHC1— which has been highly associated with Juvenile Myoclonic Epilepsy (JME). Currently, there are gaps in our knowledge in how the structures of MIPs contribute to their overall function. Knowing the essential pieces of MIPs, especially Rib72A/B, could guide our understanding of MIP interactions and perhaps lead to improved treatment for ciliopathies such as JME. Interestingly, previous research has shown that knockouts of one or both of these proteins lead to a loss of multiple MIP densities when analyzed by cryo-electron tomography (cryo-ET) suggesting these proteins have the ability to recruit other MIPs to the luminal surface of the stable microtubule. Although we see Rib72A/B may play a role in recruiting other MIPs, it is largely unknown what component(s) of their structure allows them to do so. Therefore, we are using cryo-ET and molecular biology techniques in Tetrahymena thermophila to investigate which domains are responsible for this recruitment to gain a deeper understanding of MIP interactions.

Mathematical Modeling, Automated Manufacturing, and Verification Testing of Low Cost Magnetorquers for 3 Axis Control for UC Davis CubeSat Mission

Chris Andrade
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS magnetorquer coil development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. In hopes to launch a platform for future Earth science based missions and offer guidance for other low-cost university nanosatellites, this presentation will discuss the optimization and manufacturing process for a single unit configuration of 1 air core and 2 torquer rods. Through extensive mathematical modeling coupled with physical testing for verification, a customized configuration can be designed and manufactured in-house. The selection of magnetorquer dimensions and materials were determined through research and analysis to meet system detumbling and desaturation requirements. To efficiently manufacture the prototype, a coil winder was designed, assembled, and programmed. This adaptive and modular coil winder is designed for reliability and repeatable prototyping. The information to create highly-customizable magnetorquer structure with a coil winding device can be utilized as tools by other universities and research institutions with little to no experience in CubeSat development by significantly lowering the barrier of entry and expanding mission scope.

Discourse Surrounding Black and Mixed-Race Women's Hair in Relation to American Beauty Standards

Chara Andrews
Sponsor: Kimberly Nettles-Barcelon, Ph.D.
Gendersexuality Womensstudies

Beauty standards for women in America have been and continue to be a social issue for the female gender. However, when it comes to defining the ideal standard for beautiful hair, black and mixed-race women's kinks and curls are often viewed as the opposite of beautiful. The roots of black hair and the negative perceptions that have been attached to it stems from the American slave trade, and the black woman's experience in America is intrinsically related to her hair. The present project will examine the discourse surrounding black and mixed-race women's hair in the form of a documentary film. My analysis explores the complexities of cultural identity, self-esteem, and beauty perceptions through hair. Ultimately, the purpose of this project seeks to reverse negative stigmas surrounding black hair by tracing the history of this topic and identifying cultural and societal influences. The importance of this research is to disseminate a narrative that no longer separates "good hair" from "bad hair".

Using Laboratory Observation Protocol to Analyze Teaching Practices in Chemistry Laboratories

Xavier Antoine-Goeas
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Beginning in Fall 2017, the Chemistry Department at UC Davis started a pilot program through which undergraduate teaching assistants, formally known as Emerging Scholars (ES), have been working with graduate teaching assistants (TA) in laboratory settings. In order to observe and study the differences in student interactions with the TAs and the ESs, every TA and ES was asked to audio record their conversations during two lab sessions. After the audio data were collected, they were first transcribed, and student interactions with the lab instructors were coded using Laboratory Observation Protocol for Undergraduate STEM (LOPUS). Findings of this study will reveal whether students are more comfortable approaching TAs or ESs, and how the teaching styles may vary between the two lab instructors. Student inquiries and TA's or ES's responses will be carefully examined to better understand the instructional styles in the labs. These observations and analyses will reveal the efficacy of the Emerging Scholars program and provide the guidelines to enhance student learning experiences.

Influence of Iron Supplementation on Development of the Gut Microbiota of Preterm Infants

Bianca Arao
Sponsor: Mark Underwood, M.D.
MED: Pediatrics

The infant gut microbiota is associated with health outcomes. Factors that influence early development of the gut microbiota of an infant include vitamin and mineral supplementation. This study explores the relationship between iron supplementation and the gut microbiota of preterm infants. This study included 21 preterm infants with a fecal sample collected up to 1 week before and a fecal sample collected as long as possible after the start of iron supplementation. The 16S rRNA gene was sequenced from fecal DNA. Data were analyzed using QIIME2 and R. Alpha diversity (Shannon Index) was compared before and after iron supplementation using generalized estimating equations, adjusting for sample collection day of life and repeated samples. Beta diversity (Bray-Curtis) before and after iron supplementation was visualized through non-metric multidimensional scaling (NMDS) and significance was tested using PERMANOVA. There was no significant difference in alpha diversity ($p=0.35$) by iron supplementation. There was no significant difference in beta diversity ($p=0.25$) before and after iron supplementation. There was no difference in the number or distribution of bacteria species, and communities remained similar before and after iron supplementation. Future work will explore if individual taxa are differentially abundant before and after iron supplementation.

Educating Future Veterinarians and Health Care Providers on How to Overcome Language Barriers

Montserrat Armero
Sponsor: Lorena Garcia, Ph.D.
MED: Public Health Sciences

As the U.S. becomes more diverse, the number of pet owners and health care patients with limited English proficiency (LEP) is increasing. Overwhelming research has shown that language barriers (LB) can contribute to health disparities. Policies have been put in place to provide language access (LA) services in health care, but these requirements are not always met. Minimal research has been done to show the impact of LB and how to overcome them in veterinary care, even though communication is essential to care. The purpose of this project was to provide an LB educational intervention to pre-vet/health undergraduate volunteers in the Knights Landing One Health Center (KLOHC). The KLOHC is a no-cost clinic that offers both medical and veterinary care to the town of Knights Landing, and provides these services largely to Spanish speaking, rural underserved farmworkers. The LB education intervention included didactic lecture and discussion activities. To assess the effectiveness of the LB educational intervention the knowledge assessment questionnaire and course feedback was administered before and after the program.

Identification, Characterization, and Implementation of Effective Biocontrol Agents and Natural Plant Compounds to Protect Pruning Wounds from Grapevine Trunk Disease Pathogens

Molly Arreguin
Sponsor: Akif Eskalen, Ph.D.
Anr Plant Pathology

Grapevine trunk diseases (GTDs) pose a great threat to the stability of global grape production. Fungal pathogens that induce Esca, Bot canker, and Eutypa dieback are particularly detrimental to vineyards, causing widespread damage and reduced yields. GTD-related pathogens infect primarily through the exposed wood vessels of pruning wounds. Current control methods treat pruning wounds with chemical protectants, which have reduced efficacy over time due to resistance development. A promising alternative is the utilization of naturally occurring microorganisms found on the surface of pruning wounds (epiphytes) and within xylem sap of freshly pruned spurs (endophytes) as biocontrol agents. Our research aims to discover possible microorganisms and plant compounds to be used as biocontrols to protect pruning wounds and manage GTDs. Isolated epiphytes and endophytes were identified using molecular and phylogenetic analysis. In vitro inhibition bioassays measured how effectively biocontrol candidates inhibited and suppressed the growth of two prevalent pathogens: Eutypa lata and Neofusicoccum parvum. Several species within the genera of Aureobasidium, Bacillus, Fusarium, and Trichoderma displayed significant levels of control over selected GTD pathogens. Inhibition assays against pathogens associated with Esca are currently underway, and future greenhouse and field trials will evaluate the efficacy of our biocontrol candidates.

Effect of Upcycled Food On Broiler Weight Gain

Zaira Arteaga
Sponsor: Annie King, Ph.D.
Animal Science

In the U.S., approximately 133 billion pounds of food are wasted, contributing 18% of methane from landfills. Reducing food placed in landfills will lessen the impact of climate change. As well, growth of the U.S. and worldwide poultry industry demands new, less costly and available feed that will produce food (meat and eggs) for a growing global population. Repurposing food wasted along the food chain can provide more feed for poultry. Efforts are underway to reuse grocery store/supermarket waste (vegetables, fruits, bakery food, meat, and fish) as poultry feed. Therefore, the objective of this study was to feed diets containing nonpathogenic upcycled grocery store waste to determine the effect on final weight of broiler (meat-type) chickens. Broiler chicks (3-day-old) were fed a basal diet (Control), Control + 9.5% upcycled food, and Control +13.5% upcycled food in 3 phases (2 weeks each) as starter, grower, and finisher. Feed and water were provided ad libitum. Weekly weights were determined for a completely randomized design with significance at $P \leq 0.05$. Weights were statistically similar across diets. Initial results suggested that feeding upcycled food can produce broilers of desired market weight. More statistical analyses for feed consumption and feed conversion ratio are underway.

Ethnic Identity and School Belonging in Diverse High Schools

Liana Atizado
Sponsor: Adrienne Nishina, Ph.D.
Human Ecology

It is important to understand factors that promote school belonging, as it is associated with positive outcomes. This study examines how strongly different subscales of ethnic identity are correlated with school belonging. The study drew from a larger longitudinal study following students from ethnically diverse high schools. Participants were 671 tenth grade students (28.2% White, 25.0% Latinx, 15.2% Asian/Pacific Islander, 5.4% African American, 16.7% Multiethnic). Students reported on the degree to which their ethnic identity plays a role in their personal identity (centrality), their views on their ethnic group (private regard), and their beliefs about how others perceive their ethnic group (public regard). There was a positive correlation between private regard and school belonging $r(670) = .32$, $p < .05$, as well as between public regard and school belonging, $r(670) = .28$, $p < .05$. When the data were disaggregated by ethnicity, a similar pattern was found for White, Asian/Pacific Islander, and Latinx students: both private and public regard were positively correlated with school belonging. However, for multiethnic students, only public regard was correlated with school belonging. These findings provide insight into how the formulation of ethnic identity may differ between monoethnic and multiethnic students.

Treatment of corneal epithelial cells with andrographolide results in a time-dependent induction of the antimicrobial peptide human ß-defensin 3 (gene: DEFB103, peptide: hBD-3)

Theint Aung
Sponsor: Brian Leonard, D.V.M.,Ph.D.
VM: Surg/Rad Science

Antimicrobial peptides (AMPs) are naturally occurring antibiotics that are synth by epithelial cells and phagocytic leukocytes as the first line of defense. They have broad-spectrum antimicrobial activity against bacteria, fungi, and viruses. During corneal injury, AMPs are synthesized by corneal epithelial cells and exhibit direct antimicrobial activity to promote corneal epithelial wound healing. Importantly, AMP expression can be upregulated by inflammatory cytokines and the recognition of pathogens. A recent study demonstrated the upregulation of single AMP, human beta-defensin 3 (DEFB103), from an intestinal colonic epithelial cell line treated with compounds derived from herbal medicines (i.e. andrographolide). The purpose of this study was to determine the ability of andrographolide to induce DEFB103 expression by a human corneal epithelial cell line in a time-dependent fashion (1 hour, 2 hours, 4 hours, 6 hours, 24 hours). Indeed, 75 uM of andrographolide induced DEFB103 expression by 2-fold as soon as 4 hours after treatment, yet had maximally induced expression by 500-fold by 24 hours. Therefore, the treatment of corneal epithelial cells with andrographolide has the ability to significantly augment host defenses the upregulation of DEFB103 expression, having direct clinical application in patients with infectious diseases of the cornea.

Effects of Traffic Noise Exposure on Mate Assortment and Settlement in Breeding Tree Swallows, *Tachycineta bicolor*

Kylie Avery
Sponsor: Gail Patricelli, Ph.D.
Evolution & Ecology

Anthropogenic effects, such as noise pollution from traffic, are present throughout the world and will continue to increase with the expansion of transportation networks. Increased noise level has been shown to have negative effects on tree swallows by increasing stress and reducing growth in nestlings. In this study, we tested whether there is a relationship between male and female tree swallow nest site selection and noise level. We also looked at how this affected male and female pairing by quality (eg. health and condition). Using a spectrophotometer, we measured feather brightness as an indication of individual tree swallow quality on samples collected from male and female tree swallows during the breeding season. Higher quality birds have brighter and more saturated blue back (mantle) feathers, and brighter white breast feathers, than lower quality birds. Understanding how nest site noise levels impact mate pair assortment based on feather characteristics could have further implications on the reproductive success in this population.

Investigating how the Circadian Clock Regulates the Chromatin Landscape to Maintain Genomic Stability in *Drosophila melanogaster*

Dominik Aylard
Sponsor: Joanna Chiu, Ph.D.
Entomology/Nematology

The circadian clock is an endogenous timing mechanism that coordinates many biological processes including cell cycle progression. The mechanisms by which the circadian clock regulates organismal physiology and behavior include transcriptional regulation as well as chromatin remodeling. In Drosophila melanogaster, the chromatin remodeler BRAHMA (BRM) interacts with key clock transcription factors to orchestrate daily cycles of chromatin condensation and relaxation, facilitating rhythmic gene expression at clock-regulated loci. I hypothesize that the rhythmic chromatin landscape regulated by BRM also plays a role in preventing DNA damage by temporally separating transcription and replication, which use the same DNA template. Interference between these two processes results in a phenomenon known as transcription-replication conflicts (TRCs), which may stall replication and cause damage to the DNA. To test my hypothesis, I will use Proximity Ligation Assay (PLA) in rapidly dividing intestinal cells of flies expressing different mutations of brm to detect TRCs by measuring the close proximity between the replisome and transcriptional machinery. My results will further elucidate the role of circadian rhythm in maintaining the genetic landscape to prevent the accumulation of DNA damage.

Analyzing the Effect of Assignment Structures on Students' Problem-Solving Performance in Chemistry

Tarek Bacha
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

The questions in the practice assignments given to students in the form of worksheets or other formats are often grouped by chapter, topic, or concepts. There is a great emphasis on categorization. Most of the end-of-chapter problems in chemistry textbooks are organized by sections. Although this was done with the intention of helping students navigate the assignments more easily and practice in order, it is not what they are expected to do during the tests. There is a mismatch between what they practice on and how they are tested. The goal of this study is to examine the influence of the structure of the assignments on students' problem-solving performances. Two groups of students from chemistry classes will be recruited to participate in this study. Each group will have the same length of practice and identical questions with only one difference. The experimental group will have assignments with mixed questions, while the control group will have traditional assignments with the questions organized around chapters and topics. Students will complete three two-hour long sessions during the weekends. Evaluation of their progress will consist of their written thinking process and one pre-test and three post-tests, with one given after each problem-solving session.

Influence of Diet and Probiotic Type on Preterm Infant Gut Microbiome

Brittany Baikie
Sponsor: David Mills, Ph.D.
Viticulture & Enology

The gut microbiome influences preterm infant health. Breastmilk feeding and provision of probiotics are known to influence the term infant microbiome, but the combined impact of diet and probiotic on the microbiome is understudied in preterm infants. To test the influence of diet and probiotic type on the preterm infant gut, preterm fecal samples were collected. Fecal DNA was 16S rRNA sequenced with analysis in QIIME2 and R. Association between alpha-diversity (Shannon Index) and diet/probiotic was tested using regression. Association between beta-diversity (Bray-Curtis) and diet/probiotic was tested using PERMANOVA. 14 infants fed a mix of formula and breastmilk received Bifidobacterium longum subspecies infantis. 10 infants fed only breastmilk received Lactobacillus reuteri. 14 mixed fed infants received probiotic L. reuteri. Alpha diversity was associated with diet (mixed fed higher, p=0.038), and with probiotic (L. reuteri higher, p=.037). Beta-diversity differed significantly by probiotic (p=0.03), but not by diet (p=0.70). This suggests that supplementation of L. reuteri instead of B. infantis or mixed feeding instead of exclusive breastfeeding results in colonization with more bacterial species. Beta-diversity results show that the gut microbiome composition of infants given L. reuteri differs from that of infants given B. infantis, while composition was similar between diets.

Effect of a Ketogenic Diet on Acetylation in Kidneys

Nicole Baker
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Aging is the progressive functional decline of the body and mind. Exercise may slow aging through improved fat metabolism across all tissues. Similarly, a ketogenic diet (KD) increases fat metabolism and may slow aging. The purpose of this study is to determine how long an individual must maintain a KD before biochemical changes are evident. In this study, male C57b/6 mice were fed a continuous control diet or a KD for 1, 2, 3, 6, or 7 days. Following the dietary intervention, the kidneys were collected, processed, and western blots were performed to detect total acetylated proteins, and the acetylated versions of p300, p53, H3K27, and H3K9. We found that total acetylation increased from day 3 on KD and was highest after 7 days on KD. These data suggest that increases in protein acetylation continue during the first 7 days of a KD. Further investigation is required in order to determine whether the effect is maximal at day 7 and whether intermittent KD has the same effect as a continuous KD.

Developing Novel Cellular Therapeutics for Treating Glaucoma

Harrison Baker
Sponsor: Anna La TorreVila, Ph.D.
MED: Cell Biology & Human Anat

Glaucoma is a neurodegenerative disease affecting more than 200,000 Americans per year and results in vision loss as a result of optic nerve degeneration. Retinal ganglion cells (RGCs) connect the retina to the brain, and are the only neurons that degenerate in glaucoma. Since the human retina does not regenerate itself, novel therapeutics are required to restore vision after RGC degeneration. Current techniques for producing retinal tissue from stem cells in vitro produce relatively small numbers of RGCs. In Dr. Anna La Torre's lab, we are developing techniques to produce large numbers of RGCs from stem cells in vitro for cellular therapeutics. We know that micro RNAs (miRNAs) play a critical role in retinal development--as miRNAs increase during retinal development, the retina stops producing RGCs, and when miRNAs are inhibited, the retina produces larger than normal numbers of RGCs. Our current approach is to inhibit miRNAs in stem cell cultures in vitro to promote the production of RGCs. By targeting miRNAs, we aim to increase in vitro production of RGCs, thereby enhancing the feasibility of using stem cells as a source of RGCs for human therapeutics in the future.

The Effect and Implications of Streaming Services on Theatrical Box Office, Theatrical Releases, and Consumer Behavior

Katelyn Banh
Sponsor: Kristin Kiesel, Ph.D.
Ag & Resource Economics

I analyze the effect of streaming services (specifically Netflix) on movie box office revenue. Predicting box office numbers was developed by studies in the 1970s and has been used ever since, but streaming has yet to be included as a variable due to its recent introduction to the industry's consumer base. Determining if streaming services are a substitute or complement to attending movie theaters will have important implications for consumer preferences and predictions of future changes in the film industry. Possible effects of streaming services on the movie industry is less theater attendance and less theatrically released independent movies. My empirical analyses utilize movie data from aggregator movie websites like The-numbers.com and data on Netflix subscribers over time reported on Statistica.com. This data set allows me to run regressions that estimate overall industry impact as well as effects specific to movie genres while controlling for movie budgets, time trends and seasonal effects, as well as independent releases. My preliminary results indicate that the popularity of streaming services like Netflix does not have a significant impact on box office revenue. I am currently extending my analysis to consider whether streaming services impact the number of type of movies released in theaters.

Impaired Response of Dedifferentiated Beta Cells

Jerice Kent Banola
Sponsor: Mark Huising, Ph.D.
MED: Physiology & Membrane Biol

Nearly one in ten people worldwide have diabetes, with even more considered prediabetic. The most prevalent form, Type 2 Diabetes Mellitus (T2DM), is characterized by insulin resistance and impaired insulin release by beta cells, which normally secrete insulin to lower blood glucose levels. Recent research suggests that dedifferentiation of beta cells into an immature-like state may play a role in T2DM, presenting us with the possibility of redifferentiating them in diabetic patients to cure them; however, there is still little known about how these dedifferentiated beta cells behave. We hypothesize that dedifferentiated beta cells have improper responses to different stimuli, such as glucose. In our experiment, we aim to further characterize beta cells within insulin-resistant ob/ob mice and lean control mice to provide a greater foundation in our basic understanding of beta cell dedifferentiation. We achieve this through analysis of beta cell calcium activity as a proxy for vesicle exocytosis, post-hoc stains to investigate the extent of the regression, and testing of various receptors and ion channels known to be affected. Our data show that beta cells in insulin-resistant mice display impaired response relative to beta cells in lean mice.

E. coli Co-Expression of Novel Diterpenoids Derived from Zea mays for Stress Response Assays

Chelsea Barrett
Sponsor: Philipp Zerbe, Ph.D.
Plant Biology

Terpenes are a diverse class of organic biological compounds produced in all plants that have purposes for both plant survival and human pharmaceutical and cosmetic uses. The biological activity of terpenes is derived from a range of diverse structures in plants that arise from a singular initial terpene precursor molecule. The enzymatic modification of this precursor results in a variety of terpene backbone molecular motifs with unique structures and functional groups, giving each terpene unique biological functions. Within Zea mays, terpenes provide a major component of the plant's stress response, particularly in regards to drought and fungal disease. Many terpenes have been found to impart anti-fungal activity against major maize fungal diseases. In this project, we use an E. coli co-expression system of Z. mays terpene synthase enzymes and cytochrome P450s to produce the recently-discovered maize diterpenoids termed "dolabralexins" and their derivatives. Dolabrelexins are being studied for their role in the plant response to drought stress and fungal disease. Given recent data on increased global temperatures and crop losses from more frequent droughts, an understanding of the exact function and mechanism of dolabrelexins is essential to the growing demand for sustainable crop production to feed our growing global population.

Atomic No. 17: Downplaying the Insidious Effects of Chlorine-Bleach-Containing Products in the Cleaning Industry

Susana Barron
Sponsor: Jesse Drew, Ph.D.
Cinema & Digital Media

The health effects experienced by women in the cleaning industry while using chlorine-bleach-containing products vary from minor skin irritations to death. Air ventilation, other compounds in the environment, and protective gear are determining safety factors, but the marketing strategies used give little to no indication that potential health problems can arise. The purpose of this project is to identify the misrepresentation on the proper use of these products. My project will compare the warning labels against the marketing strategies used online. This project consists of a short film using video and photos that support my findings. My research has identified a lack of transparency with the marketing strategies of these harmful products leading to misrepresentation and abuse of trust. Marketing on social media platforms, for example, makes consumers susceptible to influencer fraud which has the potential of having the same harmful effects as "fake news." While more research is still needed, it is recommended that the marketing strategies include an accurate representation of how these toxic products should be safely used.

A Comparison of the Prevalence of Pouring Rights Contracts Between American and Global Universities

Antonia Bartz
Sponsor: Jennifer Falbe, Ph.D.
Human Ecology

Many US universities appear to have pouring rights contracts with sugar-sweetened beverage (SSB) companies. In exchange for paying a university sponsorship money, these contracts give SSB companies the rights to advertise and make their products available on campus. However, SSBs increase risk for chronic disease, and young people consume high amounts of SSBs. Although pouring rights could pose a barrier to public health, there has been no empirical research on their prevalence. The objective of this study was to investigate the prevalence of SSB pouring rights contracts at the top US and international public and private universities. US News Best Global University Rankings were used to identify the top 100 US universities and top 100 non-US universities. These universities were then contacted about pouring rights contracts, and based on their responses, were classified as having or not having SSB contracts. Preliminary findings suggest that pouring rights are markedly more common in the US (about 96%) than abroad (about 10%), but data collection is still ongoing. There appear to be large cultural differences in the approach to beverage contracts between universities in the US and abroad.

Developing and Measuring the Effectiveness of an Antibody Screen for Cytomegalovirus Detection in Rhesus Macaques

Asal Bastani
Sponsor: Jeffrey Roberts, D.V.M.
VM: Medicine & Epidemiology

Macaques are used as animal models in human biomedical research because both species share similarities. For example, cytomegalovirus (CMV) can be transmitted from mother to offspring in humans and macaques. Although human and rhesus CMV are different viruses, they can both lead to disease congenitally or within the immunosuppressed host. Detecting CMV in rhesus macaques is important for animal health, reproduction, and for lowering risks of pathogen transmission, including zoonotic exposure in research colonies. There are many ways to detect CMV within macaques including culture, antibody detection, or PCR detection. We developed and measured the effectiveness of detecting CMV by an antibody screen. To date, we have tested immunoassays using two different antigen concentrations bound to polystyrene beads or magnetic beads. After trying various combinations, we found that results are dependent on the quality of the antigen, and we're currently validating a protocol using 50 µg of antigen on magnetic beads. Results on a panel of 30 samples tested were accurate when compared to reference methods. Because CMV elicits an immune response, it has been studied as a vaccine vector. Thus, detecting CMV in macaques is important because it can be a confounding variable in interpreting research results.

Meta Learning and Cognitive Flexibility in Task Learning

Priyanka Basu
Sponsor: Steven Luck, Ph.D.
Psychology

Humans are capable of conducting entirely new tasks accurately by instruction, however there is a significant lack of research to help understand this phenomenon. Fast learning is highly involved in this process of performing untrained tasks and has the ability to deduce a "solution" to a new task very fast and efficiently by conducting recombinations of known tasks. To better understand this phenomenon, we performed experiments with a project involving a paradigm that contained more than 250,000 visual task possibilities with 1-4 targets, 5 trials per task, and each experimental session having 73 tasks to conduct. Data was collected on more than 100 college students, each performing up to 75 tasks in total. Results from this project showed that all participants scored well above chance, and most participants scored around 90% accuracy even on the first trial. Through the process of "meta-learning", participants performed even better over more trials of a task and as they performed more tasks overall. These findings highlight the process of fast-learning in humans and their ability to combine and deduce information from previous tasks conducted to fully and accurately perform new tasks.

Parent Acculturation and Children's Oral Proficiency: A Study with Head Start DLL Preschoolers

Krystal Jane Bautista
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Education

Past research has shown that the levels of immigrant parent acculturation (PA) affect their adolescents' academic success and motivation. Research has focused on adolescents from Mexcian-American families. To expand on this topic with younger children and dual language learners (DLLs) from other backgrounds, we recruited DLLs from low-income immigrant families who were enrolled in Head Start centers in Northern California. A total of 27 DLLs from Mexican-American and 81 DLLs from Chinese-American families were assessed on the Picture Vocabulary, Oral Comprehension, and Understanding Directions subtests on the Woodcock-Johnson Tests. PA was collected with the Parent Cultural Social Acculturation, Parent Family Ethnic Socialization Skill, and Parent Ethnic Identity Scales. Results reveal that there were many similarities between the two groups on PA and DLLs' bilingual proficiency. However, Mexican-American parents had higher heritage language identity and heritage language media usage than Chinese-American parents. Correlation results show that parent's self-perceived English proficiency and parental English media usage were correlated with DLLs' English oral proficiency. These results suggest that the PA levels and the bilingual proficiency of Mexican-American and Chinese-American preschoolers are more similar than different and that there may be an association between PA and DLLs' English proficiency.

Iterative Design and Analysis of Standardized CubeSat Structure

Blade Baxter
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Mechanical & Aerospace Engr

REALOP is the first UC Davis undergraduate-based CubeSat team with a launch scheduled for Spring 2021. The structures team is responsible for the design and analysis of the CubeSat frame as well as the integration of control hardware and payload. The goal is to create a structural frame independent of payload, that also provides simple integration of and accessibility to the payload, which uses standardized hardware mounting brackets for ease of mission repeatability. The mounting brackets hold different payload components and control actuators. In order to integrate the electrical PCBs and flight computers safely, a slotted housing unit, referred to as the Stackhouse, will be used to electrically isolate the PCBs from the aluminum frame. To simulate the environment that the CubeSat will experience throughout its lifecycle, research regarding the structure's ability to survive the launch environment and maintain the functional integrity of the CubeSat components will be conducted through analysis of mechanical, thermal, and vibrational loads. A standardized, independent CubeSat structure will allow for simple integration of hardware and scientific payloads for future CubeSat missions.

Septins Regulate the Diffusion of Cortical Atg9 Vesicles During Autophagy

Sriharish Bellamkonda
Sponsor: Kenneth Kaplan, Ph.D.
Molecular & Cellular Bio

The process of autophagy targets organelles and proteins for digestion in the vacuole/lysosome and is a critical pathway that ensure cell survival after cell stress, or perturbations in homeostasis such as nutrient deprivation or protein mis-folding. Induction of autophagy pathway to respond to cell stress must be balanced with their down-regulation to ensure cells return to homeostasis and maintain viability, however it is not well understood how this pathway is constrained. Upon nutrient deprivation, autophagy membranes form around cargo at an assembly site where Atg9-vesicles are trafficked from exits sites in the cortical endoplasmic reticulum (ER). Recent work in the Kaplan lab implicates septin filaments that form near cortical ER exit sites in limiting the formation of autophagy membranes. We hypothesize that septins do this by constraining the free diffusion of Atg9-vesicles at the cortical ER. We will use Atg9-3XGFP to collect high time resolution images in living wild type and septin mutant cells. We predict that septin mutants will be unable to constrain cortical Atg9-vesicles. Displacement of Atg9 vesicles will be measured using a frame-by-frame comparison algorithm.

Plastic Free Oceans: Addressing Single Use Plastic Consumption in Davis Restaurants

Alessandra Beelen
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Animal Science

The presence of plastic waste in the oceans poses a major threat to marine ecosystems. Numerous marine organisms become entangled in or unintentionally ingest plastic debris. Much of the population is unaware of the consequences of single-use plastics. This project aims to investigate single use plastic consumption in local restaurants in Downtown Davis. We surveyed local restaurants about the single-use products they offer to their customers. We distinguished which restaurants use eco-friendly products, determined how they heard about them, and evaluated the effects they have had on their business. We intend to examine the correlations between education programs, both of employees and customers, with the desire for an adoption of eco-friendly alternatives. We will quantify these impacts by investigating how much plastic can be diverted by making small changes at a local level. We aim to build a local model of community driven change that can be applied to other cities to address this global problem at a larger scale.

Stress and Memory: An Investigation of Pre-encoding Stress and Contextual Changes on Recognition Memory

Haylee Benesi
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Previous research has shown that experiencing an acute stressor after learning potentiates recognition memory when stress and learning share the same context. To explain this phenomenon, a contextual binding account has been adapted: stress enhances contextual memory, which in turn boosts memory for items within that context. This theory predicts memory enhancements from stress should be present regardless of the stressor's timing, provided they share context. However, this idea has only been tested with post-encoding stress. To test whether contextual binding theory accounts for pre-encoding stress, 52 participants were split into 4 groups based on stress and context conditions. The stress group underwent the Socially Evaluated Cold Pressor Task, while the control group performed a non-stressful equivalent. Participants then either changed contexts or remained in the same context. Afterwards, they encoded 240 negative and neutral images, and were memory tested 48 hours later. Preliminary analyses reveal that pre-encoding stress boosts recollection when context is unchanged. Additionally, stress selectively boosts memory for negative images when context is changed. These results indicate contextual binding theory does not fully account for memory performance when stress occurs before encoding. Future research should involve the fMRI to determine a neural basis for contextual binding theory.

Circadian Element, PERIOD2, Defends Cells Against Genotoxic Stress via WNT/ß-catenin Mediated Mitochondrial Bioenergetics

Jonathan Berg
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MED: Radiation-oncology

Circadian rhythms are categorized as processes which regulate metabolic and physiological changes that follow daily cycles. The importance of these internal “clocks” is increasingly evident in maintaining metabolic homeostasis in mammalian cells and preventing cancer formation. The expression of the gene PERIOD2 (PER2) plays a critical role in the maintenance of these biological pathways in adaptation of protection against environmental radiation stress. This research project reveals that PER2 is expressed when exposed to low-dosage radiation (LDR; 10 cGy) and has been shown to form a complex with glycogen synthase kinase-3ß (GSK3ß)—a significant enzyme in initiation of PER2 transcription. When measuring oxygen consumption and ATP generation from the bone marrow of PER2 deficient ($PER2^{Def}$) mice, there was shown to be weakening in the mitochondrial metabolism. Following RNA-seq of bone marrow stem cells of LDR-treated wild type (WT) versus $PER2^{Def}$ mice also revealed a cluster of genes involved in mitochondrial metabolism and DNA repair capacity. Furthermore, melatonin, a natural anti-oxidant and hypothalamic circadian synchronizer, stimulates PER2 expression and confers mice radioprotection through weight maintenance and increased survival. These results demonstrate that PER2 plays a significant role in defending mammalian cells against environmental genotoxic stress through the PER2/ß-catenin pathway.

There's a Riot Going On: Student Involvement and Protest Efficacy

Galen Berns
Sponsor: Jaime Jackson, Ph.D.
Political Science

The developed world has seen an increase in student activity in protests, resulting in social and political transformation. It is perceived that students can give a non-violent movement an exclusive advantage to fulfilling its objectives. The purpose of this project is to examine how student involvement affects the capabilities of protest movements. Specifically, I ask how does the participation of students in non-violent resistance campaigns affect the success of these campaigns? This project compares the case studies of the 2003 Serbian Otpor movement and the 1999 Iranian Student Protests. Both featured heavy involvement from students, but with differing results in goal attainment. Supplemental data from a new dataset is also utilized. I find that student involvement offers unique mobilization ability and post-campaign effects as the students leave university. This information will provide global insight and policy implications related to the shift in age demographics in the developed and developing worlds.

A Review of Current IgM and IgG Antibody Patterns in Positive Coccidioidomycosis Patients and an Examination of Cross-Reactivity with *Histoplasma capsulatum* in Immunodiffusion Testing

Lalaine Berube
Sponsor: Ian Mchardy, Ph.D.
MED: Medical Microbiology & Imm

Coccidioides is the causative fungal agent for coccidioidomycosis, which continues to have a significant impact on public health in the southwestern United States. Serology testing, particularly immunodiffusion remains the most sensitive and specific testing diagnostic testing method. The Immunodiffusion test (ID) is a qualitative test for detecting the Coccidioides PPT (IgM) and CF (IgG) antibodies. Their presence in a patient's serum or bodily fluid, followed by IgG complement fixation (CF) quantification can give invaluable information in assessing the onset and severity of disease. In this study, ID results for patients were tracked and new emerging patterns were noted. It has been documented that Histoplasma capsulatum, another infectious fungal agent can have cross reactivity for the ID and CF tests. For four months patient samples with equivocal or atypical ID results were further tested against H. capsulatum. Patterns in band position and complement fixation titers were reevaluated while history, clinical state, and other test results were obtained when possible. Results show new patterns of serology may be present for cocci patients as well as creating the start of a more standardized criteria in discovering cross reactions by Histoplasma capsulatum in Coccidioides ID and CF tests.

The Effect of Anthropogenic Noise on Provisioning Behavior in Adult Tree Swallows (*Tachycineta bicolor*)

Jessica Beskind
Sponsor: Gail Patricelli, Ph.D.
Evolution & Ecology

Anthropogenic noise, specifically traffic noise pollution, is prominent in urban areas. This noise can alter bird behaviors that contribute to reproductive success, such as communication, vigilance, and provisioning. In this study, we examined how anthropogenic noise impacts the provisioning behavior of tree swallows (Tachycineta bicolor) and how this behavior may differ between males and females. We exposed nest boxes to playbacks of artificial noise during the breeding season and transcribed the number and length of provisioning visits for males and females from video recordings. We hypothesized that provisioning rates decrease in noisy areas, with greater effects on female birds. Our hypothesis is supported by research that shows birds increase vigilance when exposed to anthropogenic noise, decreasing available time for provisioning. Noise also hampers communication between parents and nestlings, which may hinder parents’ ability to hear hunger signals from nestlings. Additionally, during settlement, female tree swallows choose nest boxes in quieter locations more often than males, which indicates that they may be more sensitive to noise than their male counterparts. Implications of noise sensitivity in tree swallows may include a significant decrease in provisioning of birds as a result of urban development, thus decreasing fitness and impacting the overall population.

Differences in Delivery Mode and Probiotic and the Effects on Preterm Infant Microbiome

Valerie Betsis
Sponsor: David Mills, Ph.D.
Viticulture & Enology

The preterm gut microbiome is associated with infant health. Delivery mode and probiotic administration influence the infant gut microbiome. The purpose of this study is to examine if preterm infant gut microbiomes differ by delivery mode when probiotics are administered. Data were collected from 32 infants, 10 vaginally delivered and 22 Cesarean section delivered. DNA extracted from stool samples collected during the first week of life was used for 16S rRNA gene sequencing. Analysis was done in QIIME2 and R. A regression model was used to test for an association between alpha diversity (measured by Shannon Index) and birthmode or probiotic. Beta diversity (Bray-Curtis) was visualized by NMDS. PERMANOVA was used to test for association between beta diversity and birthmode or probiotic. No statistically significant association was found between alpha diversity and birthmode ($p=0.45$) or probiotic ($p=0.34$). There was a significant association between beta diversity and birthmode ($p=0.022$) and probiotic type ($p=0.005$). In conclusion, the number and evenness of bacterial species found in infant microbiomes is similar for birth mode, and by type of probiotic. However, differences in infant gut microbiome community composition were found by delivery mode and probiotic type.

Upregulation of Toll-Like Receptors in the Olfactory Epithelium to Defend Against Pathogens

Megan Bettencourt
Sponsor: Qizhi Gong, Ph.D.
MED: Cell Biology & Human Anat

The olfactory epithelium (OE) is one of the few sites where environmental pathogens can gain direct access to the brain. Given this vulnerable arrangement, unique defense mechanisms must be in place to protect against pathogens. Toll-like receptors (Tlrs) are sensor molecules of the innate immune system, detecting microbial pathogens and initiating immune responses. We systematically investigated Tlr expression in the OE specifically at which Tlrs are expressed, which cell type they are expressed in, and how they are regulated after pathogen exposure. Our lab determined, by RNA-seq, that Tlr2, 3, 4 are expressed in the resting-state mouse, and all are upregulated after exposure of vesicular stomatitis virus (VSV). We further observed that Tlr3 transcripts are specifically upregulated after 24hrs of viral mimic poly-IC stimulation. Tlr3 mediated pathogen detection could be executed by either sustentacular cells or olfactory sensory neurons. Immunohistochemistry experiments are underway to determine the cell types in the OE that express Tlr3. By investigating cell type specific Tlr regulation, we hope to gain insights into predicting and enhancing the reaction of the immune system to pathogens invading the nasal cavity.

Visual Representation of UC Davis' Nitrogen Footprint

Maya Bhadury
Sponsor: Benjamin Houlton, Ph.D.
Land Air & Water Resources

Nitrogen is an important nutrient found and used throughout human and natural ecosystems. Worldwide, advanced nitrogen fertilizer technologies are estimated to support food production for over 3 billion people while developed economies have seen gains in nitrogen use efficiency by crops. However, excess amounts of reactive nitrogen can lead to declines in global health, biodiversity, and air and drinking quality when it is lost from soil. A nitrogen footprint provides a standardized measure for the amount of reactive nitrogen released by an entity, such as a university. Using ArcGIS Pro, which is a mapping application that allows us to represent numerical data spatially, we created an interactive map of the embodied and local emissions of UC Davis based on the 2018 nitrogen footprint that the UC Davis Office of Sustainability calculated. We focused on emissions from major contributing sectors such as food, utilities, transportation, research, and wastewater, as well as fertilizer and refrigerants. By visualizing the nitrogen emissions data, we hope to help individuals understand the source of nitrogen emissions on campus and assist people in making more sustainable lifestyle choices. Additionally, we hope to help campus decision makers understand the impact of operations and highlight opportunities for reductions.

Development of a Novel Propulsive Lunar Mobility and Lunar Gravity Emulating Platform

Ashir Bhalla-Levine
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the system design and concept of operations of the Lunar Emulated Hopper Platform (LEHoP), an Earth-based testbed for lunar mobility systems designed for NASA's BIG Idea Challenge 2020. With NASA putting humans back on the Moon by 2024, lunar surface exploration represents a critical component of lunar infrastructure due to necessary tasks such as locating water ice deposits. Due to these deposits most commonly occurring in the rough terrain of the permanently-shadowed regions of large craters, land rovers face significant mobility challenges and thus alternate transportation methods may be preferable. Our approach consists of a propulsive "hopping" device that ejects warm gas to enter flight, traverse terrain, and land while carrying small scientific payloads. The propulsive system utilizes unique, medium flow-rate resistojet thrusters and a ducted fan apparatus which emulates lunar gravity on Earth. Successful development of such a platform could lead to the generation of best-practices in hopper design, which would benefit future lunar exploration endeavors.

Oxytocin Receptors Differentially Regulate Social Approach and Social Vigilance in the Nucleus Accumbens

Shanu Bhela
Sponsor: Brian Trainor, Ph.D.
Psychology

Oxytocin receptors (OTR) within the Nucleus Accumbens (NAc) are known to promote social behavior. When released in the NAc, oxytocin facilitates social approach. Stressful experiences can inhibit this mechanism and in turn decrease OTR expression, leading to an increase in social vigilance, often associated with social anxiety. It is unknown whether social vigilance is affected by NAc OTR activity in the same way as social approach. Therefore, we administered stress-naïve male and female California mice with the OTR antagonist (OTA), L-368-899 and found that it reduces social approach, but it does not social vigilance. In order to better understand the signaling pathways through which social approach and social vigilance overlap, we used two biased agonists. Atosiban activates OTR-Gi coupling and inhibits OTR-Gq coupling. In turn, mice treated with atosiban showed a decrease in social approach without influencing social vigilance. However, Carbetocin, facilitated an increase in social approach and decrease in vigilance through the activation of OTR-Gq coupling. While both vigilance and approach function in different ways, there is some overlap in their neural mechanisms. Further research would allow us to utilize OT more efficiently as a therapeutic drug to help promote more social behavior for patients with psychiatric illnesses.

Experimental Eecreation of Bone Disks From Mas d'Azil: Establishing the Chaîne Opératoire of Mobile art in the Upper Paleolithic

Marlena Billings
Sponsor: Nicolas Zwyns, Ph.D.
Anthropology

The emergence of art is currently associated with Homo sapiens during the Upper Paleolithic (UP) of Europe. While art is seen in other parts of the world and is contested for earlier time periods, a large study sample in mixed media is firmly associated with the Magdalenian culture of the UP, providing opportunities for researchers to study choices in the creation of artistic objects for this time period. An experimental replicative study has been designed to reconstruct the technical stages of operation (chaîne opératoire) on a large sample of bone disks at the Magdalenian site of Mas d'Azil, France. This project provides detailed descriptions of the Magdalenian methodological approach, addressing choice of raw materials, the construction sequences, and the amount of time necessary in disk creation from start to finish. Bone used for this project are dried samples of deer and elk scapula and stone tools consisting of knapped flint flakes and burins. Comparisons between the experimental samples and published archaeological material will establish the decisions inherent in the creation of these artistic objects, and contribute to the greater knowledge of the desired properties of mobile art at the end of the Pleistocene.

Examining the Changes in the Temporal Stability of Explicit and Implicit Learning Due to Normal Aging

Guneet Bindra
Sponsor: Wilsaan Joiner, Ph.D.
MED: Neurology

Normal aging is associated with a decline in motor abilities and various learning deficits. We utilized a motor adaptation task (visuomotor rotation) to examine deficits in implicit and explicit learning due to normal aging. We recruited young (18-22 years of age) and healthy elderly subjects (≥ 60 years) to make 10cm arm reaching movements using a robotic manipulandum. Before each movement subjects rotated a dial to select an aiming direction; this represents the explicit learning component. After selecting the direction, subjects moved the cursor to the target, countering the visual feedback perturbation. Implicit learning was measured by the difference between the planned (from the dial) and actual movement trajectory. Each subject performed the task with either a 45^{o} or -45^{o} rotation of the visual feedback. We then probed the memory of each type of learning at 0, 6, 10, 20, 50, and 90 seconds. Young subjects showed nearly complete retention of explicit aiming, but implicit learning exponentially decreased with time. However, elderly subjects exhibited lower implicit and explicit stability. These results provide measures to distinguish specific memory deficits accompanying normal aging and may be beneficial in identifying memory impairments in certain neurological disorders (e.g. Alzheimer's disease).

Understanding Signaling Pathways for Degranulation and Chemotaxis in Neutrophils

Kristi Bispo
Sponsor: Sean Collins, Ph.D.
Microbiology & Molec Genetics

Neutrophils (a type of white blood cell) are an important component of the innate immune system; they act as one of the first lines of cellular defense against abnormal and invasive cells. Neutrophils rapidly respond to foreign stimulants by an ordered cell response. First, they chase the source of stimulant in a process called chemotaxis. Next, they act to kill the invasive cells by releasing degradative enzymes from stored vesicles called granules. This is called degranulation. Interestingly, the receptors activating these two unique processes are the same, yet the responses are separated. We aim to understand the differences in downstream signaling pathways that allow distinct control. We hypothesize that higher stimulus concentrations activate degranulation components that are distinct from chemotaxis signaling components. A candidate signaling branch that controls degranulation is Phospholipase C mediated signaling. I am using imaging based genetic sensors to measure differences in signaling based on stimulus concentrations. Fluorescence microscopy is being used to observe cells that have been stimulated with N-formylmethionyl-leucyl-phenylalanine (fMLF), a synthetic attractant originally isolated from Gram negative bacteria. We are writing image analysis programs to quantify observable changes and determine statistical significance.

Aphidicolin Induces Radial Chromosome Formation During One Cell Cycle

Maya Block
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Microbiology & Molec Genetics

Radial chromosomes are irregular DNA structures characterized by chromatid breaks of two or more chromosomes that have fused together. These DNA structures can have severe consequences for the cell, including disruption of protein function, irregular cell division, and development of cancer. My project aims to investigate the mechanistic timing involved in radial chromosome formation. I hypothesize that radial formation can occur during a single cell cycle. To test this hypothesis, B-lymphocytes were treated with one of the following three conditions: (1) no treatment, (2) 5μM ATRi, which blocks ATR kinase, a protein that initiates DNA repair, and (3) 0.4 μM Aphidicolin (APH), which halts DNA replication by inhibiting DNA polymerases. The data revealed radial chromosome formation after a single cell cycle in cells treated with 0.4μM APH. In contrast, no radial chromosomes formed in cells without treatment or in cells treated with 5μM ATRi. Additionally, ATRi-treated cells also exhibited significantly reduced amounts of other complex rearrangements when compared to APH-treated cells. Taken together, these data support my hypothesis that radial chromosome formation can occur during a single cell cycle and suggest that ATR kinase may be involved in the mechanism of formation.

Disparities in Cancer Incidence and Mortality on Native American Reservations

Janae Bonnell
Sponsor: Marina Crowder, Ph.D.
Molecular & Cellular Bio

Of all ethnic groups across the nation, Native Americans have one of the lowest rates of cancer survival. By virtue of the location, environment, and history intertwined with reservations, there are discrepancies in levels of cancer incidence and mortality in these areas. Furthermore, the most prevalent types of cancer for tribal nations in various geographic regions differ from those observed in the rest of the United States population. The prevalence of smoking, poverty, and employment in a hazardous occupation is higher on reservations than in other parts of the country. Also, the responsibility for healthcare on most reservations falls on the Indian Health Service, which is chronically underfunded and lacks the means to provide truly comprehensive, quality care to patients. On reservations, people also face increased carcinogen exposures that stem from the continued existence of environmental racism and the remote locations of reservations. In addition, the tenuous relationship between Native Americans and Western medicine discourages many from receiving potentially life-saving screenings and treatment. This review investigates the multitude of factors impacting disparities in cancer incidence and mortality rates on Native American reservations in the United States and examines how these factors differ from those seen in other populations.

The Impact of Experimenter Familiarity on the Sprague Dawley Rat

Shoshannah Bobritsky
Sponsor: Melissa Bauman, Ph.D.
MED: Psychiatry & Behav Sci

This study aims to identify the effects of experimenter familiarity on male Sprague Dawley rat juvenile social behavior interactions. The rats were handled by two groups, three times each: controlled single experimenter (N=10) and randomized group (N=10). Social interactions with an age/weight/sex-matched rat on postnatal day (PND) 28 were quantified via a social dyad (SD) test administered by the single experimenter to determine effects on familiarity. After testing all rats, time engaged in play, social interactions, and nonsocial activity were coded. We predict that due to experimenter familiarity, rats in the single experimenter condition may experience less stress and increased social interaction compared to those in the randomized group condition. Results from this study may determine whether experimenter familiarity can alleviate the stress that test rats undergo and whether or not it could lead to more interaction in stressful environments. If this study is significant, then it could have implications for future behavioral tests in that experimenters may have a great impact on the rats' behavioral performance.

Development of Flight Software and Analysis Tools for CubeSat Attitude Determination and Control System

Graham Bough
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS software development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Flight software is developed to determine and control the attitude or orientation of the CubeSat by integrating sensor data and giving commands to the hardware. The attitude determination algorithm, TRIAD, is developed to integrate sensor data with mathematical models to output the state of the satellite. The output is used by B-Dot and PD, which are closed-loop algorithms allowing the hardware to stabilize the satellite and point the cameras towards Earth. Integrated software and hardware testing is performed to verify that the system meets requirements. A virtual model of the CubeSat, VirtualSat, is also in development to simulate the in-orbit motion of the satellite, while taking external factors like drag, solar radiation, etc. into account. VirtualSat will be an open-source tool that will allow other missions to visualize spacecraft dynamics and develop control algorithms.

Engineering of Genetically Encoded Indicators to Monitor Neuromodulators *in vivo*

Sarkis Bouladian
Sponsor: Lin Tian, Ph.D.
MED: Biochem & Molecular Med

Behavior is driven by precise patterns of neural activity; elucidation of neural circuits requires recording of genetically-defined neuronal populations with high spatiotemporal resolution. Analytical chemistry techniques are invasive and suffer from poor spatiotemporal resolution; to overcome technical barriers, we have developed biosensors for dopamine, corticotropin-releasing factor, and other neuropeptides. These biosensors are fusion proteins of G-Protein Coupled Receptors (GPCRs) and fluorescent proteins. A circularly-permuted fluorescent protein (cpFP) is covalently linked to intracellular loop 3 (IL3) of an endogenous GPCR because IL3 is known to undergo the greatest conformational change upon ligand binding. The amino acid linkers are conformationally flexible; thus, conformational changes in IL3 induced by ligand binding are directly coupled to conformational changes and thus fluorescence increases in the cpFP. By this mechanism, the fluorescence intensity of the cpFP serves as a readout of receptor activity. Since linker residues are key determinants of the fluorescence change, we optimized the dynamic range of the sensor by performing site-saturated mutagenesis of linker residues and screened the linker library in HEK cells. We then further characterized the substrate specificity, kinetics, and membrane localization of the sensors in HEK and hippocampal cells. Ultimately, we aim to precisely study neuropeptide activity in behaving animals.

Behavioral Analysis of the Effects of Rostral Ventromedial Medullary Neurokinin-1 Receptor Expressing Neurons on Itch

Aristea Bountouvas
Sponsor: Earl Carstens, Ph.D.
Neuro Physio & Behavior

The rostral ventromedial medulla (RVM), a brain region located in the brainstem, is well known to modulate spinal pain transmission. Specifically, a group of neurons in the rostral ventromedial medulla called ON cells have been shown to facilitate pain. These neurons fire just prior to a pain response, respond to the injection of pruritogens, and express the neurokinin-1-receptor. It is unknown whether these neurons modulate itch transmission. We hypothesize that ON cells have an inhibitory effect on itch. To test this hypothesis, RVM NK-1R expressing neurons were specifically activated by chemogenetic and pharmacological approaches. Injection of substance p, the cognate ligand for NK-1R, reduced itch related behavior and facilitated mechanical pain behavior. Chemogenetic activation of RVM NK-1R-expressing neurons strongly reduced histamine and chloroquine evoked itch, but interestingly had no effect on the pain response. Altogether, our analyses explored the descending modulation of itch transmission and the specific neurons responsible for this process.

NADPH Oxidase: Structural and Mechanistic Analysis and Complex Formation

Caleb Bower
Sponsor: James Letts, Ph.D.
Molecular & Cellular Bio

The NADPH Oxidase (NOX) system is essential for creating Reactive Oxygen Species to eliminate the threat of invading pathogens. Dysfunction in NADPH Oxidase can prevent the balanced formation of Reactive Oxygen Species, too much potentially leads to neurodegeneration and too little can lead to immunodeficiency. Currently, our lab is amplifying the genes of NOX and DUOX isoforms and cloning them into circular plasmids. After confirming the correct clones by sequencing the genes, we will express the NOX isoforms in yeast cell cultures. Using this strategy, we should be able to extract and purify NOX from the yeast cells. With the purified sample we can determine the structure using single-particle cryo-EM. Determining the atomic structure of NADPH Oxidases will provide an understanding of its mechanism, and an opportunity to understand dysfunction. With this knowledge, we can reconstruct NOX complexes and test them by mutagenesis. This last stage of the project will allow us to investigate the mutant's domains, subunits, inhibitors, binding properties, and other mechanistic features that could be the cause of dysfunction.

You Are Not Your Country: Identity and Community in the Time of the Nation-State

Brenden Boyatt
Sponsor: Thorian Harris, Ph.D.
Philosophy

Over the past three-hundred years, the rise of the nation-state has radically changed the way individuals conceive of themselves, creating a sense of national identity which is inextricably tied to this political structure. This notion of national identity - itself rooted in ahistorical notions - is innately harmful, creating and reinforcing systems of thought in which we understand those outside that power structure's domain as separate from us, pushing us toward accepting a hierarchy of value centered around this perceived separation. By tying our identity to the nation state, we are separated from the transnational "other", creating in-groups and out-groups: citizen and foreigner, immigrant and native, "us" and "them". This is apparent in a variety of national projects throughout the world, and under a variety of ideological perspectives. It is apparent in India's hindutva movement and Japanese imperialism, but also in countries which supposedly value inclusivity -- the 'nation-of-immigrants' United States, and even Singapore's self-consciously multicultural attempt at national identity. Through historical and philosophical examination, one thing is clear: the national model of identity is intrinsically divisive.

Relationships Between Infant Fecal pH and Growth of Breastfed Rwandan Infants

Savannah Boyd
Sponsor: Jennifer Smilowitz, Ph.D.
Food Science & Technology

Growth failure, or stunting, is the most common manifestation of malnutrition globally and is estimated to affect about 160 million children each year. It is particularly pervasive in low- and middle- income countries where food availability and certain measures of sanitation are strikingly low. A historically underrecognized player in this process is the gut microbiota, including its microbial inhabitants and metabolic functions. Over the past decade and more specifically these past few years, researchers have been delving into the details of this mysterious microbial habitat to understand which of its characteristics are intimately involved in human processes and how. Specifically, my project will be focusing on the relationship between infant fecal pH and anthropometric growth outcomes in breastfed infants in a small community in Rwanda. I will be analyzing the relationship between the infants' fecal pH and the prevalence of stunting, wasting, and underweight using statistical analysis software. I hypothesize that a higher fecal pH will be positively correlated with the following negative growth outcomes: stunting (height-for-age z-score <-2 standard deviations below the World Health Organization (WHO) growth standards median), wasting (weight-for-height z-scores <-2 SD below the WHO median), and underweight (weight-for-age z-scores <-2 SD below the WHO median).

Analysis of Qatar's Female Labor Force Participation Rate

Elise Boyle
Sponsor: Suad Joseph, Ph.D.
Anthropology

Qatar professes the highest female labor force participation rate (58.43%) out of states in both the Gulf Cooperation Council (GCC) and the Middle East and North Africa (MENA) region. A common theme in these regions are large numbers of women earning tertiary degrees, but not working in private or public sector jobs afterwards–which makes the case of Qatar interesting. In this paper, I study the reasons behind Qatar's high female participation rate and the paradox between Iraq, which is a similar high oil-reserve country whose female labor force participation rate is 11.18%. Qatar's literacy rate for both men and women increased dramatically following the discovery of oil and natural gas, although the years of education was lower for women. Investment in education and policies elevating the status of women in the early 2000's contributed largely to a smaller gender disparity in Qatar. Understanding the connection between policy, gender, and culture will help countries develop policies to address gender disparities in the workforce.

Potential Adaptation of Yellow Starthistle (*Centaurea solstitalis*) to Serpentine Soils

Katherine Brafford
Sponsor: Mohsen Mesgaran, Ph.D.
Plant Sciences

Yellow starthistle (Centaurea solstitalis), a highly invasive noxious weed in California and the western United States, was largely not found in habitats with serpentine soils. Serpentine soils, which present chemical and physical barriers to plant growth, are relatively common in California, have produced numerous endemic species, and are largely free of invasive plants. However, based on nonsystematic observations, starthistle is seemingly becoming more common on supposed serpentine soils. Our objective is to examine whether some starthistle populations are developing genetic adaptations which allow them to grow and compete on serpentine soils. We selected otherwise similar serpentine and non-serpentine site "pairs" with starthistle present from four geographically disparate areas within California, collected soil and seed samples, and performed germination tests at different water potentials. Seeds originating from serpentine populations consistently had higher germination rates than seeds from "paired" non-serpentine populations indicating potential genetic differences. We will test the soil samples to determine their "serpentine character" and conduct a reciprocal common garden experiment with seeds and soils from "paired" sites to test for phenotypic differences. Our findings will inform the actions of land managers, whose land includes areas with serpentine soils, and advance the understanding of weed invasion into difficult environments.

Identification and Cultivation of Fungal Isolates Associated with the Seagrass, *Zostera marina*

Neil Brahmbhatt
Sponsor: Jonathan Eisen, Ph.D.
MED: Medical Microbiology & Imm

Seagrasses are marine flowering plants that are globally distributed and serve important functions in a variety of ecosystems. From studying land plants, we know that fungi can be really important for plant health. However, seagrass-associated fungi, along with marine fungi more generally, remain an understudied part of biology. In this project, I sought to isolate fungi belonging to the genus Coniochaeta from seagrass tissues and worked more generally to expand general fungal isolation efforts. Using a variety of media types and salt concentrations, I isolated and cultured a number of fungal isolates with varying morphology, including some black yeasts. I extracted DNA from these fungal isolates and performed polymerase chain reaction (PCR) on the internal transcribed spacer (ITS) and 28S ribosomal RNA gene regions to identify these fungi. Currently, I am preparing these PCR products for Sanger sequencing in order to build fungal phylogenetic trees and confirm my fungal identifications. By expanding knowledge of these fungi, we can investigate potential connections to the evolution of land plants and make implications for their importance for seagrass health.

Supervised Learning Approaches for Measuring the Effects of Age, Gender and Speciation on Neuron Electrophysiology

Tyler Brassel
Sponsor: Gerald Quon, Ph.D.
Molecular & Cellular Bio

Nearly one in five US adults suffer from some kind of mental illness, and one in ten suffer from a neurodegenerative disease. Changes to neurons within the brain are thought to play an important role in many of these phenotypes. However, little is known about how the response of individual neurons to electrical impulses varies with biological factors such as age or gender. In this study, we explore the use of supervised machine learning approaches to learn how a neuron's electrophysiological response to stimulus changes with various biological factors. More specifically, we combine both molecular (transcriptional) and cellular (electrophysiological) measurements made on thousands of individual neurons spanning individuals from across the lifespan, as well as across human and mouse, in order to identify the determinants of variation in neuron electrophysiology. Ultimately, we hope to tie these results back to the genetics of psychiatric disorders, in order to resolve uncertainty over how genetic variants associated with those disorders functionally impact the brain.

Electrographic Phenotypes of Epileptogenesis in a Rodent Model of Temporal Lobe Epilepsy

Olga Brevnova
Sponsor: Gene Gurkoff, Ph.D.
MED: Neurological Surgery

Epilepsy, characterized by spontaneous recurrent seizures, affects approximately 65 million people worldwide. The most common form of focal epilepsy, temporal lobe epilepsy, is characterized by both electrographic phenotypes including, altered oscillations, seizures and interictal spikes (IIS) as well as cognitive dysfunction. It is unknown how these electrographic phenotypes develop over time (epileptogenesis), and if they can function as a prognostic biomarker. We hypothesized that IIS rate and changes in theta during epileptogenesis can predict functional outcome in chronic epilepsy. We used the pilocarpine model of temporal lobe epilepsy to evaluate animals with a clear epileptogenic period. Electrodes were implanted unilaterally in the prefrontal cortex, medial septal nucleus, and dorsal and ventral hippocampus of adult male Sprague-Dawley rats, which were then randomly assigned to sham (n=11) or pilocarpine (n=13) groups. Spike rates and theta power were analyzed from biweekly recordings during epileptogenesis. Chronically epileptic rats underwent Novel Object Recognition testing, and spontaneous seizure rates were quantified from 168 continuous hours of LFP recordings. We correlated spike rate and theta power throughout epileptogenesis to these functional outcomes, aiming to establish a linear regression model that can aid prognostic evaluation for epilepsy patients.

Synthesis and Duplex Stability of N2-Alkyl 8-Oxo-2'-deoxyguanosine Oligonucleotides for use as Substrate Analogs for DNA Repair Protein MutY

Madeline Bright
Sponsor: Sheila David, Ph.D.
Chemistry

Reactive oxygen species cause oxidative damage to nucleobases in DNA which results in 8-Oxoguanine (8-OG), a common oxidative product which mispairs with adenine. Such 8-OG:A mispairs cause G:C to T:A transversions upon DNA replication, a build-up of which is destructive to the cell. MutY, a base excision repair (BER) enzyme, combats oxidative damage to guanine nucleobases in DNA by cleaving the mispaired adenine. This cleavage results in an abasic site across from 8-OG, which is repaired by downstream BER enzymes. Inherited variants of MUTYH, the human homolog, have been linked to the initiation and development of carcinogenesis. How MutY is able to differentiate the mispaired adenine from correct T:A pairs is the focus of my research in Sheila David's lab. This work will determine the effect of steric bulk and hydrogen bonding imparted by the 2-amino of 8-OG on the target recognition mechanism of MutY via 8-Oxo-2'-dG analogs modified at the 2-position. It will also analyze the duplex stability of produced oligonucleotides. Synthetic analogs will help reveal the structural features dominant in MutY's target recognition of the 8-OG:A mispair when subjected to binding, kinetics, and cellular repair assays.

She's Got to be From Out of Town: Effects of a Poleward Range Shift of the Southern Nudibranch *Phidiana hiltoni* on Resident Nudibranch Species

Michael Brito
Sponsor: Eric Sanford, Ph.D.
Evolution & Ecology

A series of warm water anomalies in the Northeastern Pacific during 2014-2016 led to poleward range shifts in a substantial number of marine species along the California coast, including the southern nudibranch Phidiana hiltoni. Earlier work suggested that the predatory P. hiltoni can cause declines in resident species nudibranch diversity and abundance. In this study, we tested whether the northward range expansion and the new arrival of P. hiltoni in Bodega Bay has negative impacts on three resident nudibranchs (Hermissenda opalescens, Flabilina trilineata, and H. crassicornis). In a laboratory experiment, we exposed these three resident nudibranchs to water-borne cues from P. hiltoni, and monitored their feeding and sheltering behaviors. We also quantified the outcome of direct interactions between P. hiltoni and the three resident species by observing their physical interactions when placed in close proximity. Our findings suggested F. trilineata tended to feed less and spent more time avoiding a perceived threat when in the presence of P. hiltoni. In contrast, the other two species did not appear to be strongly affected by the presence of P. hiltoni. Our findings may inform further research that seeks to understand how these poleward range shifts may affect species interactions in coastal communities.

Comparing Integer Linear Programming to SAT-Solving for Hard Problems in Computational and Systems Biology

Hannah Brown
Sponsor: Daniel Gusfield, Ph.D.
Engr Computer Science

There are many problems in computational biology for which it is useful to have solution methods that don't require the development of individual algorithms. One such general method, called integer linear programming (ILP), formulates problem instances as a system of integer linear inequalities, which can then be solved to find solutions to the problem instance. ILP has had success in a wide range of problems, but there are some where it is unable to find solutions within a reasonable amount of time. We explored the use of an alternative method that has received little use in computational biology: satisfiability solving (SAT-solving), which encodes problem instances as Boolean formulas and uses a SAT-solver to determine if the formulas are satisfiable or not. In two problems where ILP had little success, we found that SAT-solving was dramatically better; both arriving at solutions more quickly and finding solutions to larger problem instances than ILP could. For a third such problem, SAT-solving was slower than ILP but showed less variance in the times it took to find solutions. These results encourage further research into the use of SAT-solving, as the success of SAT-solving could have a significant impact in computational biology.

Helping Infants Learn Language: Do Parents Exaggerate Speech Sounds When Talking to Infants?

Danielle Bucks
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

Caregivers often alter their speech when speaking to infants, using a speaking style known as infant-directed speech (IDS). The current study explores this phenomenon by investigating whether parents hyperarticulate, or exaggerate speech sounds, to make their speech more clear when talking to infants. Specifically, we are investigating how parents vary their production of "t" sounds in speech towards infants versus adults. We are coding emphasized and reduced "t" sounds (e.g. 'cheetah' pronounced with a clear "t" versus a "d" sound; 'cat' produced with a clear versus dropped "t"). Parents engage in two sessions of interactive tasks—first with their infant (11-month-olds and 19-month-olds), then with an experimenter. Parents are asked to incorporate a set of consistent target words to encourage the use of words with "t" sounds across both speaking registers. Sessions are audio and video recorded and analyzed for the "t" articulation as well as the positioning of the target words in sentences. Our preliminary data includes 10 participants, but coding is ongoing. We predict that parents try to present helpful language learning tools to their infants. Therefore, they will produce more clear speech to their infants than to adults, showing more hyperarticulation in IDS.

Science to Empower: Environmental Conflicts in Ecuador using the EJ Atlas

Alexandra Bucheli
Sponsor: Mark Lubell, Ph.D.
Environmental Science & Policy

Environmental problems in Ecuador have led to disproportionate impacts in Andean and Amazonian indigenous communities. Environmental conflicts are interesting to study in Ecuador due to the abundance of natural resources, biodiversity of the landscape, and diversity of urban and indigenous communities that use the environment in different ways. By using the EJAtlas, a global tool documenting environmental justice (EJ) conflicts, we analyze cases in Ecuador for different tactics of violence, forms of community mobilization, and multi-sector (government, corporate, community-based) actors involved. We observe patterns in how communities' methods of resistance and the different magnitudes of violence relate to whether cases achieved justice or not. We expect to see domestic and international violence in certain geographical regions, neo-extractive activities in biodiverse hotspots, and an overall lack of access to legal justice and assistance, which may be leading some communities to use alternative strategies outside of existing formal legal tools. This project aims to better understand how certain tactics of environmental violence, involvement of different types of actors, and forms of community resistance and mobilization influence the visibility and outcomes of EJ conflicts, emphasizing the importance of monitoring, documenting, and supporting environments and communities on the frontlines of mega-projects and resource exploitation.

Phylogenomic Evaluation of Gigantism in a Model Wolf Spider (Lycosidae, *Schizocosa*)

Ashley Bui
Sponsor: Jason Bond, Ph.D.
Entomology/Nematology

Distinguishing the roles between natural and sexual selection in trait evolution is an essential part of evolutionary biology. Strategies for attracting mates often come in the form of ornamentation, behavioral displays, vibrational signaling, and size. Although behavior, signaling, and ornamentation in Schizocosa have typically received large amounts of attention, size has not nearly received the same level of study. The 23 nominal Nearctic Schizocosa currently occupy a wide range of habitats and exhibit considerable differences in traits that may be under sexual selection. However, some species are morphologically similar, making species delimitation, diagnosis, and subsequent identification difficult. Such a situation is observed in the ostensibly similar species of S. maxima and S. mccooki where their separation predominantly relies on size differences relative to much larger S. maxima individuals. Here we evaluate the evolution of size, particularly in Schizocosa species distributed in western United States, where gigantism of S. maxima is observed. We use sub-genomic data within the context of a comparative phylogenetic framework to evaluate morphological traits and test evolutionary hypotheses related to genetic clustering of populations and size. From these results, we have gained a more comprehensive understanding of an often-neglected component of character evolution in the genus Schizocosa.

Culturing and Identification of Beneficial Anaerobic Microorganisms in Coral (*Montipora digitata*)

Camille Burke
Sponsor: Jonathan Eisen, Ph.D.
MED: Medical Microbiology & Imm

Due to rising oceanic temperatures and ocean acidification, coral reefs are increasingly at risk from worldwide bleaching events. Bleaching occurs when coral symbionts, which supply their host with essential nutrients, leave the coral due to unfitting conditions. Without the symbiont, the coral is left vulnerable to disease, starvation, and ultimately death. The term Beneficial Microorganisms for Coral (BMC) describes specific symbionts that help to promote coral health. The aim of this study is to further develop and optimize culturing strategies to grow and identify BMCs using the coral Montipora digitata, specifically anaerobic microorganisms. These anaerobic symbionts rely on gases other than oxygen to support their biochemical reactions. The symbionts that had been isolated from M. digitata fragments were grown on Marine Broth Agar in an anaerobic chamber system. DNA was extracted from visible colonies and 16S rRNA genes were amplified through PCR then sequenced for identification. It is hoped that the information gathered from the identification of the M. digitata symbionts will allow us to eventually develop a probiotic that will increase the coral's resistance to bleaching.

Secondhand Smoke Impairs Potassium Channel Function in Resistance Arteries

Abby Burns
Sponsor: Madeline Nieves-Cintron, Ph.D.
MED: Pharmacology

Secondhand smoke (SHS) has deleterious vascular effects, then can lead to increased incidence of vascular complications, including stroke and hypertension. The mechanisms linking SHS exposure to vascular complications are poorly understood. Impaired vascular smooth muscle contractility may be a key contributing factor. Vascular smooth muscle contractility is dependent on a dynamic interplay between different ionic conductance that help control membrane potential (excitability) and the level of intracellular calcium ([Ca2+]i). The activity of a number of potassium (K+) channels regulates vascular smooth muscle membrane potential, which also has a major influence on intracellular Ca2+ through the regulation of voltage-gated L-type Ca2+ channels. Our experiments show that arteries from mice exposed to SHS have elevated pressure-induced constriction (e.g. myogenic tone). This was correlated with depolarized membrane potential of vascular smooth muscle cells, which in turn was linked to a decrease in the activity of K+ channels. RT-PCR analysis showed downregulation of calcium-activated potassium (BK) channel alpha subunit, this was consistent lower expression of BK alpha subunit at the plasma membrane of vascular smooth muscle as revealed by proximity ligation assay. Thus, our results suggest that SHS affects vascular smooth muscle contractility by altering the functional expression of K+ channels.

Sleep Patterns and Socioeconomic Impact in Mexican American Families

Rosalina Burton
Sponsor: Leah Hibel, Ph.D.
Human Ecology

Irregular sleep patterns have been tied to low quality sleep and increase mortality, most notably, an increased risk for cardiovascular disease (Huang, Mariani & Redline, 2020). The California Babies Project is a study of Mexican origin children and their families. It is a longitudinal project studying the impact of stress on children's development of self-regulation, and in the long run, how this affects children's mental and physical health. Participant families are assessed when the child is 6 months, 18 months, 3 years old and 4 years old. Data regarding socioeconomic status (SES) and actigraphy-recorded sleep patterns of child and parent are collected during these assessments. I expect to find a positive correlation between increases in SES and consistent sleep patterns. Understanding the role that SES plays in sleep patterns is essential to grasp the full scope of impact that SES can have on the health of both mother and child. The population under study is the fastest growing population in the United States and discoveries would allow for further research into possible risk and prevention.

Determining Drivers of Free-living Nitrogen Fixation in Forest and Converted Pasture Soils of the Brazilian Amazon

Corinne Butler
Sponsor: Jorge Rodrigues, Ph.D.
Land Air & Water Resources

The leading cause of deforestation in the Brazilian Amazon is for the establishment of cattle pasture. This large-scale shift in land management causes changes in biogeochemical cycling of key nutrients. In particular, nitrogen fixation (the conversion of non-reactive N_2 to biologically-available ammonia) by free-living soil microbes increases following pasture conversion. This is an energy-intensive process requiring high availability of low-complexity carbon substrate as an energy and nutrient source. Furthermore, the high energy cost likely restricts the performance of this function to nitrogen-limiting conditions. However, previous analysis of total and permanganate-oxidizable carbon (proxy for labile) revealed no significant differences between forests and converted pastures. I measured labile carbon using an alternate extraction procedure to determine variation by land type. Additionally, I measured reactive nitrogen pools including ammonia, nitrate, and total dissolved nitrogen to determine if this may be a limiting nutrient in pasture soils. Furthermore, because of their old age, tropical soils have a unique nutrient profile. Therefore, I measured plant-accessible phosphorus and iron content to determine what role these may play in microbial activity. By measuring key nutrient pools, we can improve our understanding of how land use change drives shifts in microbial composition.

The Roles of the Proteins Dmc1 and Rad51 in Homologous Recombination

Nadejda Butova
Sponsor: Sean Burgess, Ph.D.
Molecular & Cellular Bio

Meiosis is a type of cell division that results in four gametes for sexual reproduction, each with half the number of chromosomes of the parent cell. Using the zebrafish Danio rerio as the model organism, I am studying the role of DMC1 within meiosis. Dmc1 is required for homologous recombination in every model organism that has it. Our lab made the interesting discovery that Dmc1 seems to be dispensable for meiosis in zebrafish. While the fish are fertile, the quality of the gametes has not been assessed. My project is to test if the Dmc1 mutants exhibit increased levels of aneuploidy (i.e. having the wrong number of chromosomes due to segregation errors). I am doing this by analyzing the quality of the embryos that develop from dmc1-/- mutant parents. I found that while the majority of the embryos develop normally, there is a slight elevation in the number of deformed embryos. This result explains that while Dmc1 appears dispensable for meiosis, it has been retained during evolution in zebrafish. One future direction is to see if the distribution of Rad51 protein localization differs when comparing WT and Dmc1.

Identifying Zyxin Proximal Proteins during Mitosis by Proximal Biotinylation

Reca Caballero
Sponsor: Soichiro Yamada, Ph.D.
Biomedical Engineering

Physical forces emerged as a key regulator of tissue regeneration and homeostasis. Zyxin, a focal adhesion protein, is thought to be a molecular force sensor, yet we know little about zyxin's role in downstream signaling. Interestingly, zyxin interacts with CCAR-1, a nuclear protein involved in regulation of apoptosis, suggesting a potential role of zyxin in nucleus. We hypothesized that there may be other nuclear proteins interacting with zyxin. In newly divided cells, zyxin localizes in the nucleus along with other proteins. Identifying such proteins could imply meaningful protein-protein interactions to help us understand the function of zyxin in the nucleus. By using a combination of cell synchronization techniques and proximal biotinylation, we have identified potential zyxin binding partners in mitosis. We first optimized a synchronization protocol that reproducibly yields about a 40% mitotic index, using the chemical inhibitors RO-3306 and thymidine. By tagging zyxin with a promiscuous biotin ligase (TurboID), proteins proximal to zyxin were biotinylated. Then, we purified and identified the proteins biotinylated by TurboID with bead-based affinity capture and mass spectrometry, respectively. Identification of zyxin binding partners will be an essential clue for unraveling zyxin's nuclear role and its possible significance in force-activated gene regulation.

Visual Representation of UC Davis' Nitrogen Footprint

Brenton Cai
Sponsor: Benjamin Houlton, Ph.D.
Land Air & Water Resources

Nitrogen is an important nutrient found and used throughout human and natural ecosystems. Worldwide, advanced nitrogen fertilizer technologies are estimated to support food production for over 3 billion people while developed economies have seen gains in nitrogen use efficiency by crops. However, excess amounts of reactive nitrogen can lead to declines in global health, biodiversity, and air and drinking quality when it is lost from soil. A nitrogen footprint provides a standardized measure for the amount of reactive nitrogen released by an entity, such as a university. Using ArcGIS Pro, which is a mapping application that allows us to represent numerical data spatially, we created an interactive map of the embodied and local emissions of UC Davis based on the 2018 nitrogen footprint that the UC Davis Office of Sustainability calculated. We focused on emissions from major contributing sectors such as food, utilities, transportation, research, and wastewater, as well as fertilizer and refrigerants. By visualizing the nitrogen emissions data, we hope to help individuals understand the source of nitrogen emissions on campus and assist people in making more sustainable lifestyle choices. Additionally, we hope to help campus decision makers understand the impact of operations and highlight opportunities for reductions.

Neural Correlates of Natural Reading in Younger and Older Adults

Anyk Cajucom
Sponsor: John Henderson, Ph.D.
Psychology

While many cognitive processes decline with age, reading does not seem to be one of them. However, it is unclear if natural reading and comprehension are maintained in the brain across the lifespan, or if other brain regions compensate for natural neural decline. To investigate this question, we conducted a functional magnetic resonance imaging (fMRI) experiment in which older and younger adults read paragraphs of texts naturally to themselves in the scanner. Whole brain activation was compared across groups. We hypothesize that if maintenance within the reading network is occuring, we would find little to no differences in active brain regions during natural reading for each group. However, if our results support neural compensation, we would find differences in active brain regions during natural reading across groups. Our data supports the hypothesis that reading areas are maintained with healthy aging. However, we also find that activation within these areas is less prominent, possibly because of neuronal tuning or natural atrophy that comes with age. These findings contribute to the understanding of healthy aging which can aid in the identification of potential abnormalities in cognitive aging, such as early detection of dementia and Alzheimer's disease.

Investigating the Biochemical Diversity of Rubisco, Nature's Most Abundant CO_2-fixing Enzyme

Rick Vermon Callado
Sponsor: Patrick Shih, Ph.D.
Plant Biology

Atmospheric CO_2 is "fixed" into life through one enzyme: Rubisco. In plants, Rubisco catalyzes the addition of CO_2 into sugars to sustain photosynthetic organisms, and our entire food supply. Additionally, Rubisco is found across all three domains of life, and is thought to be one of the oldest enzymes on the planet. However, non-plant Rubiscos are infrequently studied, thereby limiting our understanding of one of the earliest hallmarks of terrestrial life. Thus, we aim to purify a diverse set of Rubiscos for kinetic measurements in order to collect data from a broader selection of modern enzymes. To date, we have expressed a variety of Rubiscos, including those from cyanobacteria, proteobacteria, and archaea, in E. coli and are purifying them by affinity chromatography for kinetic assays. We anticipate that the characterization of these Rubiscos that we have expressed and purified will help us better understand the biochemical variability of Rubiscos in nature, as well as re-examine some of the fundamental assumptions about the evolution of life on Earth.

Ozone Exposure Changes Expression Patterns of Phase I and Phase II Enzymes in the Lung

Destiny Cambero
Sponsor: Laura Van Winkle, Ph.D.
Cntr For Health & Environment

Ozone exposure decreases peak lung function in humans and may be associated with structural changes in the distal lung. Our prior work established that early life ozone-exposure induces abnormal lung growth. This study will investigate how these changes occur by examining the expression of key Phase I and II enzymes that metabolize and detoxify chemicals. Although their main role is to detoxify chemicals, including ozone, these enzymes may also produce harmful metabolites. Female rats were exposed to 0.5 ppm ozone from postnatal day 7 to 28 or to filtered air (FA). Samples were taken 3-4 days post-ozone exposure (juveniles) and after recovery in FA (adults). We assessed conducting airway and alveolar gene expression in the juvenile lung using microdissection and qRT-PCR as well as global expression patterns determined using 3' tag seq. Genes involved in the production of metabolizing enzymes (Cytochrome P450 enzymes, Phase I) were significantly different between ozone and FA exposed groups. Airway antioxidant enzyme responses (Glutathione S-transferase Pi, GST-pi, Phase II) were measured using qRT-PCR. GST-pi was increased in the proximal airways and reduced in the distal airways of females exposed to ozone. Ozone changes the balance of lung activating (Phase I) and detoxifying (Phase II) enzymes.

Using Eye Tracking and Standardized Assessment to Explore Cognition in Autism

Emily Camp
Sponsor: Susan Rivera, D.V.M.,Ph.D.
Psychology

Short-term visual recognition memory can be indexed by presenting a novel target geometric pattern alongside a previously familiarized pattern. Prior research using this paradigm suggests that visual preference to the novel target in infancy predicts later cognitive ability. The present study uses a novelty preference task and the Mullen Scales of Early Learning (MSEL) to characterize the cognitive phenotypes of children with Autism Spectrum Development (ASD) and Typical Development (TD). Passive infrared eye-tracking (Tobii X60) was used to measure visual preference to the novel target. Data were collected from 11 TD participants (9 male, mean age = 35.16 months, mean MSEL DQ = 105.32) and 27 ASD participants (24 male, mean age = 37.22 months, mean MSEL DQ = 60.44). There was no correlation between visual preference to the novel target and MSEL DQ in the TD group, $r(7) = -.01$, $p = .98$, or the ASD group, $r(17) = .01$, $p = .96$. However, visual preference to the target was greater in TD than ASD from 0-2000ms after onset of the novel stimulus, Welch's $t(30.91) = 2.31$, $p = .03$. These findings suggest visual recognition memory is less robust in ASD than TD participants.

Screening Yeasts for Antibacterial Activity Against *Escherichia coli*

Megan Campbell
Sponsor: Kyria Boundy-Mills, Ph.D.
Food Science & Technology

Antibiotics are an essential weapon to fight human and animal infections. However, new antimicrobials are needed because antibiotic resistant bacteria are increasing, and not all bacteria have an antibiotic that works effectively against them. In the wild, yeasts have a variety of mechanisms to defend against and kill competitors, such as bacteria, and could be a source of new antimicrobial compounds. Over 600 strains belonging to over 300 species of yeast from the Phaff Yeast Culture Collection were screened for antibacterial activity against a non-pathogenic strain of E. coli. Antibacterial activity was tested using a growth inhibition plate assay. Each plate had a lawn of E. coli and three wells that contained a soft gel with live yeast. The diameter of the zone of clearing around each yeast was measured to determine the effectiveness of any antibacterial compound produced by the yeast. A few strains from the collection have clear signs of antibacterial activity against this strain of E. coli. These yeast belong to multiple different families. Future work will include testing activity against other target bacteria, and identification of the active compound.

Isotopic Insights Into Mobility in American Samoan Archaeology

Alexandra Campbell-Grey
Sponsor: Jelmer Eerkens, Ph.D.
Anthropology

Teeth are synthesized from the food and water an individual ingests. Teeth grow sequentially at different stages of life and do not remodel, from in utero (deciduous teeth) to approximately 23 years old (when the permanent third molar completes growth). Resources such as food and water can vary in isotopic composition over a given landscape. The layers of enamel and dentin that comprise the tooth therefore, reflect the diet and locality of an individual while those layers were forming. Oxygen in human tissues comes mainly from water sources. Due to evaporation processes, water bodies can vary in their underlying oxygen isotopic composition. Therefore, changes in human mobility can be represented by shifts in $\delta^{18}O$ in layers of teeth. By comparing male and female oxygen isotope ratios we investigate sex-biased mobility patterns from sixteen individuals dating between 200 and 1100 years ago in American Samoa. We are especially interested in determining whether these societies had a preference for matrilocal (males marry into the community of their wife) or patrilocal (females marry into community of husband) postmarital residence pattern.

Drug Induced Changes of Plasticity in Rodent Brain

Ariana Campos
Sponsor: Jennifer Whistler, Ph.D.
MED: Physiology & Membrane Biol

Opioids are important analgesic drugs and are the standard of care for serious post-surgical pain. However, their repeated use leads to side effects. The primary target of opioid drugs are opioid receptors. Stimulating the opioid receptors promotes the release of dopamine, activating dopamine receptors and resulting in further physiological effects. Repeated use of opioids causes a number of both biochemical and behavioral changes. These include loss of the D2 dopamine receptors and increases in the endogenous opioid, dynorphin, in two specific brain regions called the nucleus accumbens and the hippocampus. Understanding how these chemical signals are contributing to the side effects of opioid drugs in the nucleus accumbens, involved in the reward pathway, will aid in a better understanding of opioid addiction. We have been examining how alterations in D2 receptor number and dynorphin activity alter plasticity in rodent brain and in rodent behavior. Our goal is to identify potential molecular targets for intervention in the opioid crisis.

New Titanium (III) Amido Complexes: The Search for Titanium (II)

Phuong Anh Cao
Sponsor: Philip Power, Ph.D.
Chemistry

The ongoing challenge of organometallic chemistry is to stabilize unusual geometries, coordination numbers and oxidation states of metal atoms. One of the cases that is not well studied is two-coordinate titanium (II) complexes. Despite being implicated in many reaction mechanisms, no examples of low-coordinate Titanium (II) have been isolated. Previous attempts in the Power Lab to isolate such complexes by reduction of titanium (III) species have been unsuccessful, resulting in either no reaction or ligand activation and formation of the more stable titanium (IV) complex. The isolation of low-coordinate titanium (III) and titanium (II) complexes is crucial for exploring the reactivity and physical properties of titanium in such an environment. This project aims to investigate the ability of two different amide ligands in stabilizing titanium complexes of various oxidation states and the subsequent effects on reactivity. During our investigation, we have successfully isolated a new three-coordinate titanium amide and a mixed halide-amide complex. Current efforts focus on isolating vanadium complexes as well as exploring the use of other amide ligand in stabilizing titanium (III) species and titanium (II) complexes.

Screening for *Bremia lactucae's* Immunity Suppression Effectors

Jesus Cardenas
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Plants and plant pathogens are constantly in battle with each other. Bremia lactucae (downy mildew) is a major pathogen that infects lettuce around the globe, decreasing crop yields and causing profit loss for farmers. Weaponized proteins synthesized by downy mildew infects and hijacks lettuce cells to maintain a living host environment where it thrives. B. lactucae accomplishes this feat by secreting suppressor effectors that block the immune system and the resulting localized cell death in lettuce cells, thus allowing the pathogen to grow within the plant and continuing its infectious cycle. My research focuses on screening downy mildew effectors for immune suppressor candidates. I have created chimeric fusions between the fluorescent protein mCherry and candidate suppressing effectors and introduced them into Agrobacterium through the Gateway cloning process. I then expressed the candidate suppressor with an elicitor of cell death in Nicotiana benthamiana to determine if the candidate suppressor causes suppression of cell death. This research will help us to better understand how downy mildew proteins are able to suppress the plant immune system.

Graphic Design that Grows

Emily Carlson
Sponsor: Katia Canepa Vega, Ph.D.
Department Of Design

A large segment of the graphic design industry revolves around paper and ink, which are two items that contribute to carbon emissions and pollution. Paper products have short lifespans, but are mass produced constantly despite their environmental impact. However, mycelium is a fungus based material that is biodegradable and is being used to replace furniture and packaging, and could be used in graphic design. It has a wide range of density from thin to thick, and has the ability to change its shape using direction, size, and color. I am investigating how to make use of the properties mycelium possesses while it is alive. I am testing for different methods of controlling growth patterns of mycelium from direction, to density, to color for applications in the design field. This contribution could allow for visual displays that would be interactive while reducing the environmental impact of the industry as it would replace previous harmful methods. I will investigate these different growth methods by growing mycelium substrates and comparing their growing patterns when exposed to different stimuli. With the data I gather I will prototype a mechanism to control the mycelium's growth in a way that would support a visual display.

Cone-Beam Computed Tomography and Canine Temporomandibular Joint Osteoarthritis: An Agreement Study

Nicole Carr
Sponsor: Boaz Arzi, D.V.M.
VM: Surg/Rad Science

Temporomandibular joint (TMJ or "jaw joint") disorders are common in people, affecting an estimated 12% of the population. Recent research indicates that TMJ disorders are also common in animals and that arthritis is the most common disorder of dog TMJs. Cone-beam computed tomography (CT scan) is a valuable diagnostic tool used in veterinary and human medicine to visualize osseous structures. This study aimed to correlate CBCT findings of naturally occurring TMJ disorders with characterization via gross and histopathologic evaluations. TMJs (n=38) were evaluated using CBCT for amount of periarticular new bone formation, subchondral bone sclerosis, joint space narrowing, and subchondral/cortical bone changes. Radiographically, 34 mandibular heads and 36 mandibular fossas had sclerotic changes, and 31 TMJs had some degree of joint space narrowing, thus indicating that subchondral bone sclerosis and joint space narrowing were the most common radiographic findings. Upon gross evaluation, majority of specimens (39%), had between 10-25% surface area affected by cartilage defects. Histologically, changes included fibrillations, areas of cell death, articular cartilage loss, subchondral bone exposure, and subchondral bone sclerosis. It is expected that statistical analysis results will show a correlation between amount of degenerative joint changes noted in the CBCT scans and gross and microscopic evaluations.

Comparing Various Types of Feature Pre-Activation During Language Comprehension

Gina Casaccia
Sponsor: Tamara Swaab, Ph.D.
Psychology

When comprehending language, words have features that allow people to anticipate successive words. When words with predictable features appear, the brain's processing mechanisms can suppress neighboring words, so less neural activity is seen when anticipated words follow priming/predictive words. A possible explanation for this phenomenon is that words with a predictable feature may allow for successful pre-activation of information that is likely to appear next. Unexpected words require a revision mechanism, producing a greater amplitude and mismatch negativity event related potential (ERP) known as the N400. To better understand predictive processing of information, one must investigate which types of features, whether only at the semantic-level or perhaps additionally at the orthographic and/or visual-level, are used to pre-activate anticipated words. In this EEG study, we used ERP data to compare predicted vs. unpredicted target words using a prediction paradigm (Brothers, Swaab & Traxler, 2015) to examine how pre-activation of lexical features modulates language processing.

Foundations: Helping College Freshmen Thrive Through Mentorship

Julia Castro
Sponsor: Bryan Enderle, Ph.D.
Chemistry

Forming significant relationships, identifying and growing in areas of personal weakness, and developing personal values are all important parts of one's college experience. Many students experience significant difficulty as they learn how to develop these skills, especially in their first year at a university. I am studying how to help students in the Navigators at UC Davis, a faith-based club, be successful in these aspects of their undergraduate experience by implementing a 6-week program for college freshmen. A preliminary survey suggests that these first year students struggle to create meaningful friendships outside of facilitated groups and to take practical steps to live out self-identified personal values. In order to address these difficulties, small groups of freshmen met weekly with seniors to learn about older students' experiences and discuss common values. In these meetings, an additional expectation to practice goal-setting and to initiate interactions with peers of all ages was set for participants. The aim of this study is to analyze the importance of mentorship relationships and peer accountability in helping younger students in this club develop the skills needed to succeed in college.

Energy Savings by Using Reflective Paint on Exterior Walls at the UC Davis Campus

Chloe Celniker
Sponsor: Alan Meier, Ph.D.
Environmental Science & Policy

UC Davis is considering using highly reflective paint on external walls to save energy and decrease greenhouse gas emissions. Reflective paint stops solar energy from entering and warming buildings, so the campus would use less air conditioning. UC Davis uses a significant amount of energy on building cooling, especially during the summer. I will determine the feasibility of UC Davis's reflective paint plan by compiling data on the age, net wall area, orientation, and chilled water usage for a representative set of buildings. I have already performed surveys taking thermal infrared images of walls in the summer, found the proportion of painted buildings on campus, and measured the existing paint albedo. Next, I will calculate the energy, cost and estimated CO_2 savings from switching to reflective paint. I will use my results to provide an action recommendation to UC Davis. I am working in affiliation with Berkeley Lab and the Energy Efficiency Institute.

Virgin Beta Cells Display Heterogeneous Functional Responses

Chielsea Joice Cenal
Sponsor: Mark Huising, Ph.D.
MED: Physiology & Membrane Biol

About 1.25 million Americans suffer from Type 1 Diabetes (T1D), an autoimmune disease that destroys insulin-producing beta cells resulting in unregulated blood glucose levels. Thus, significant research aims toward treating T1D by restoring beta cell mass. To this end, we discovered a new population of immature beta cells named virgin beta cells that express insulin but lack key beta cell maturity markers, including the hormone Urocortin3 (Ucn3) and the Glucose transporter 2 (Glut2). Virgin beta cells hold the potential to serve as a possible novel source to generate new beta cells, but critical questions about their function remain unanswered. This study seeks to determine the functional behavior of virgin beta cells to secrete insulin in response to high glucose compared to coexisting mature beta cells. To test this, we assayed the calcium response of 25 virgin and 300 mature beta cells in intact islets over time through live imaging. We observed some virgin beta cells that showed a pulsatile calcium response that is synchronous with functioning mature beta cells, while others displayed an impaired response. Future steps include identifying, characterizing, and understanding the factors that contribute to the different calcium responses observed among virgin beta cells.

Effect of Anesthetic Induction on the Measurement of Diastolic Function

Adam Chaban
Sponsor: Neal Fleming, M.D.,Ph.D.
MED: Anesth & Pain Medicine

Diastolic dysfunction (DD) is the result of impaired left ventricular (LV) relaxation, with or without reduced storing forces, and increased LV chamber stiffness. DD exists in over 50% of patients presenting for cardiac or high-risk non-cardiac surgery and is an independent predictor of adverse postoperative outcome specifically associated with prolonged ventilation, death, and longer ICU and hospital length of stay. The goal of this project is to determine how diastolic function changes before and after anesthetic (propofol) induction. The Institutional Review Board approved study attains informed consent from patients undergoing elective surgery where monitoring of arterial line pressure was part of the intraoperative management. Transthoracic echo measured peak early mitral flow velocity (E), peak late mitral flow velocity (A), and lateral mitral annular tissue Doppler velocity (e') before and after propofol induction. DD was graded using an algorithm that took into consideration the e' and E/e' ratio. Grades included: grade 0 (normal function), grade 1 (impaired relaxation), grade 2 (pseudo-normal) and grade 3 (restrictive). There was a statistically significant decrease in E, A, and e' after the propofol induction. The number of DD cases increased, but the consequent change in the distribution of the diastolic functional grades was not significant.

Visualizing Carbon Sequestration and Soil Health through the Incorporation of Hedgerows in Agricultural Landscapes Throughout Yolo County

Gavin Chaboya
Sponsor: Anthony O'geen, Ph.D.
Anr Land Air & Water Resources

Prior research suggests hedgerow incorporation into agricultural landscapes increase the carbon sequestration potential while positively affecting soil health properties. While hedgerows have many beneficial effects, they are only used within a small fraction of agroecosystems. The goal of this project is to quantify the effect of hedgerows relative to their spatial extent by creating dynamic geospatial mapping software through geospatial information systems (GIS) using data gathered from soils sampled across Yolo county. To apply these dynamic features, two land classifications will be used, hedgerows and cultivatable referencing the data collected from the sampled sites. Using the GIS program ArcGIS Pro, a script will be created in python and applied to each site sampled in order to measure the amount of potential carbon stored using various interpolation methods. A subset of hedgerows and cultivatable classifications will be identified manually using satellite images found through the geospatial data gateway (GDG) then projected across Yolo county using deep learning tools in ArcGIS Pro. The models produced within this project may provide growers and policy makers with the tools to accurately measure the effects of various land management practices within agriculture landscapes at minimal cost.

Effects of Lactoferrin on Placental Development

Sandra Chan
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Lactoferrin (Lf) is an iron-binding protein, found in human secretory fluids, such as amniotic fluid. Lf is a pleiotropic protein involved in various bioactivities, including cell proliferation and differentiation. Lf may contribute to placental development since a high concentration of Lf appears in the human trophoblast. Currently, effects of Lf on placental development remain unclear. Here, we hypothesized that Lf promotes placental development. To address this hypothesis, a mouse model and a human trophoblast cell model (BeWo cells) were used. Lf expression in different mouse tissues was first analyzed by isolating RNA from different mouse tissues/organs including mammary gland, bone marrow, liver, and placenta for qRT-PCR analysis. The results showed high concentrations of Lf transcripts in the placenta. To determine functions of the abundant Lf in the placenta, BeWo cells were treated with Lf (50-250 µg/mL) for 72 h and then effects of Lf on placental differentiation were evaluated by qRT-PCR of two trophoblast differentiation markers, human chorionic gonadotropin ß-unit (hCG-ß) and hSyncytin-2. The results showed that Lf treatment significantly up-regulated transcription of these two differentiation markers. Put together, Lf is abundantly present in the placenta during pregnancy and may promote placental differentiation.

Site-specific O-Glycoproteomic Analysis of Human Serum Glycoproteins Enhanced by Solid-phase Enrichment for Improved Disease Biomarker Discovery

Vincent Chang
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

The surfaces of human cells are naturally glycosylated through post-translational modification (PTM). Glycoproteins participate in several important cellular events such as fertilization, trafficking, and immune responses. In particular, glycoproteins in serum have been widely investigated, and several disease-related biomarkers were discovered. However, glycoproteomic analysis of the O-glycosylated proteins falls behind compared to N-glycoproteomic analysis, which is currently quite advanced. Therefore, we developed a method to enrich and analyze O-glycoprotein specifically. In our method, Sigma standard serum was denatured using tris(2-carboxyethyl)phosphine) (TCEP). The free thiol was subjected to react with maleimide group functionalized biotin so that the proteins can be immobilized using streptavidin beads. Glycoprotein samples were treated with PNGase F before trypsin digestion, and O-glycopeptides were enriched using hydrophilic interaction chromatography (HILIC) solid-phase extraction (SPE) cartridges and analyzed by Thermo Orbitrap Fusion Lumos nanoLC-mass spectrometry (MS). The tandem mass spectra collected from the Orbitrap were searched against the human proteome database and an in-house serum O-linked glycan library using the Byonic software. The identified O-glycopeptides combined with glycopeptide retention time prediction and UHPLC-QqQ conditions optimization is then used to develop a dynamic multiple reaction monitoring (dMRM)-based strategy to monitor these O-glycopeptides as biomarker research and discovery simultaneously.

Understanding the Role of Starch Structure on its Function as a Dietary Fiber

Jessica Chao
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

The majority of the food consumed by the world is composed of carbohydrates. The largest component of these carbohydrates is starch. Some of these starches, termed resistant starches, are not digestible by the GI tract and can function as a dietary fiber. These structures have important impacts on human health largely via interactions with the gut microbiome. Despite the strong dietary reliance on starch as a fiber source, relatively little is known about how starch structure impacts its function. In this work, glycosidic linkage analysis was performed on a variety of starchy foods to compare their structural features, namely their degrees of branching and polymerization. Food samples were permethylated with iodomethane and sodium hydroxide in dimethyl sulfoxide. These permethylated samples were then subjected to hydrolysis with trifluoroacetic acid and subsequent derivatization with 3-methyl-1-phenyl-2-pyrazoline-5-one. The derivatized glycosides were then analyzed by UHPLC-QqQ-MS/MS operated in MRM mode using a 15-minute separation. Future work through will focus on how this structural information correlates to digestibility using both standard assays and LC-MS-based methods. This will further our understanding of the correlation between starch structure and function, which can ultimately improve dietary interventions.

Examining the Relation Between Grit and Pre-Competition Anxiety in College Athletes

Hailey Chatterton
Sponsor: Emilio Ferrer-Caja, Ph.D.
Psychology

Anxiety prior to competition is a very well-documented experience among athletes, and so are the various techniques that athletes use to cope with such a state. What is currently unknown, however, is whether grit (i.e., passion and perseverance toward long-term goals) can help athletes cope with their pre-competition anxiety, and influence their performance and well-being. This study investigates the relation between grit and pre-competition anxiety in a sample of approximately 500 competitive athletes at the University of California, Davis. Participants completed a questionnaire that included measures of grit, anxiety, and demographic information. Grit was measured using the Grit Scale, and anxiety levels, coping strategies, and general well-being were assessed using the Competitive State Anxiety Inventory-2 and the State-Trait Anxiety Inventory. The results of this study may provide insight regarding whether grit can serve athletes as a tool to cope with increased anxiety, and may provide athletes and coaches with a framework for better understanding how grit and anxiety may impact athletic performance.

Overexpression of Human RNase H1 in mouse B cells Induces R-loop Formation

Kelly Chau
Sponsor: Frederic Chedin, Ph.D.
Molecular & Cellular Bio

R-loops are three stranded nucleic acid structures, in which an RNA strand anneals to a complementary DNA strand and displaces the template DNA strand from the DNA duplex. These structures play a role in immunoglobulin class-switch recombination (CSR) of B cells, modulating the production of different classes of antibodies upon detection of an antigen. Human RNase H1, an enzyme that degrades R-loop structures, was overexpressed in B cells to resolve these R-loop structures in order to test for the effects of R loops on CSR. Unexpectedly, R-loops remained in the genome of B cells and CSR frequencies were also unaffected. To better understand the impact of RNase H1 on B cells, we measured gene expression globally using RNA-seq. Differential gene expression analysis is used to identify RNase H1-responsive genes. Gene ontology analysis will be used to identify cellular pathways and biological processes that are impacted by RNase H1 expression.

Techniques for Inexpensive and Accessible Microfluidic Chip Manufacturing

Valerie Chau
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

RNA-sequencing allows for single celled transcriptional profiling. In an effort to make RNA-sequencing more accessible at a low cost, our team built a quick, reliable, and affordable microfluidics droplet controller. The device utilizes chips with engraved channels to direct droplet flow. Droplet microfluidics relies on high resolution channels to produce droplets capable of encapsulating individual cells. To improve the ability of the chips to consistently create droplets, 3-D printing and low-cost photolithography methods were assessed for their ability to create high resolution channels. To validate both the performance of the device and the capability of each fabrication technique, molds for an encapsulation chip were manufactured at various scales, which were then used to create droplets. Chip production methods were assessed on the following criteria: ease of production, manufacturing time, and ability to produce uniform droplets. Our team aims to produce protocols for both methods of microfluidic chip making. Since both methods are less expensive than the traditional chip making procedure, these protocols should provide value to any lab aiming to inexpensively employ microfluidics. When finished, our team hopes that our work will provide greater access to microfluidics and single-celled transcriptomics for researchers both on and off campus.

CaMKII and PLB Phosphorylation in a Novel GlcNacylation-Resistant (CaMKII S280A) Mouse

Navya Chauhan
Sponsor: Julie Bossuyt, D.V.M.,Ph.D.
MED: Pharmacology

Uncontrolled diabetes leads to hyperglycemia, a condition associated with cardiac dysfunction and increased arrhythmia risk. Higher activity of calcium/calmodulin-dependent protein kinase II (CaMKII) plays a crucial role in the development of these pathologies. We assessed if preventing CaMKII activation by O-GlcNacylation can limit the activation of CaMKII and its targets such as Phospholamban (PLB). Hereto we used a knockin mouse model expressing O-GlcNacylation-resistant CaMKII (S280A). We then analyzed CaMKIIdelta expression and phosphorylation as well as that of its targets in the heart via Western Blot analysis. Quantification of the signals indicate that at baseline these S280A mice and their wild type littermates have no difference in the expression level or phosphorylation of CaMKII nor in that of the CaMKII target PLB. Further experiments examining the effect of hyperglycemia in these mice are ongoing. Our results suggest that these GlcNacylation-resistant CaMKII knock-in mice can be used to assess the contribution of CaMKII GlcNacylation in the development of cardiac pathologies under high glucose conditions. This tool will aid in understanding the role of CaMKIIdelta in diabetes.

Investigation into Expression of Spikelet per Spike Gene Variants in Tetraploid (*Triticum turgidum ssp.durum)* Wheat Using Quantitative Real-Time Polymerase Chain Reaction

Micah Chavez
Sponsor: Jorge Dubcovsky, Ph.D.
Plant Sciences

Understanding genes that underpin wheat yield potential can aid in developing superior varieties. One trait affecting yield potential is number of spikelets per spike (SNS) – which determines the maximum number of florets and grains that can be formed per spike of wheat. A gene associated with a change in SNS is the WHEAT ORTHOLOG of APO1 (WAPO1), which was recently identified. One major difference between gene variants for WAPO1 was the presence-absence of a 116-bp deletion in the promoter region of WAPO-A1, the A-genome copy of WAPO1. I performed several quantitative real-time polymerase chain reaction (qRT-PCR) experiments to determine if there are differences in gene expression across the different WAPO-A1 alleles. For the qRT-PCR experiments, developing spikes were harvested at the time when the terminal spike is formed, which determines SNS. RNA was extracted from the tissues and the transcript levels of WAPO-A1 were measured relative to an active ACTIN endogenous control. Plants carrying WAPO-A1 allele with the intact promoter showed higher WAPO-A1 expression compared to plants with the promoter deletion. This finding suggests that the promoter deletion is associated with changes in WAPO-A1 expression and it may contribute to differences in SNS and hence to wheat yield potential.

Comparison of Davis and Malawi Infants on Visual-spatial Attention Development

Zhijun Chen
Sponsor: Lisa Oakes, Ph.D.
Psychology

Visual-spatial attention, the ability to orient one's attention to objects in space, develops significantly over the first postnatal months as indicated by developmental changes in visual search (Kwon et al. 2016) and spatial attention tasks (Ross-Sheehy et al. 2015). However, little work has been done in low-resource countries outside of North America. To address this gap in the literature, we used an adaptation of the IOWA (Infant Orienting With Attention) task designed by Ross-Sheehy et al. (2015) to assess visual-spatial attention development in infants in rural Malawi, Africa. In addition, we compared the result to a sample of infants in Davis, California. This task measures the speed and accuracy of eye movements under several cueing conditions: when a target appears where a cue had previously appeared (valid), when a target appears in a different location from where a cue had previously appeared (invalid), when the cue is entirely neutral (double), and when there is no cue. Analyzing data from these two samples will allow us to evaluate the effectiveness of this type of assessment in the low-resource environment and to compare visual-spatial attention development in Davis and Malawi infants.

Correlates of Health, Environmental, and Animal Rights Motives to Consider a Plant-based Diet

Sophia Chen
Sponsor: Christopher Hopwood, Ph.D.
Psychology

The increasing popularity of plant-based (vegetarian or vegan) diets has coincided with a large literature on the motivations for dietary choices. However, most studies have focused on differences between plant-based dieters and omnivores. Less attention has been paid to differences between people who have different motives to switch to a plant-based diet. However, the correlates of different motives for the same behavior can reveal interesting patterns of moral cognition and have applied value (e.g., in marketing or advocacy). In a previous study, we identified three common motives for plant-based diet: health, the environment, and animal rights. We also identified patterns of psychological variables that distinguished these motives among people with a range of dietary preferences. The goal of this study is to replicate and extend these previous findings by examining the correlates of health, environmental, and animal rights motives to consider a plant-based diet. Preliminary results show that the health and animal motives have more significant correlates with personality and attitude measures than the environmental motive and being male is negatively correlated with the animal and environmental motives.

Economic Causes and Consequences of the U.S.-China Trade War

Ruohan Chen
Sponsor: Bagher Modjtahedi, Ph.D.
Economics

In 2018, the U.S. government under President Trump unexpectedly increased tariffs on the imports of several goods from China, which caused China to retaliate immediately by increasing tariffs to the imports of some goods from the U.S. This is a classic example trade war. Our research will focus on specific economic causes and consequences of this U.S.-China trade war. To understand the root cause of this problem, we will study the history of economic conflicts between these two countries in recent years. Like any trade war, to understand the U.S.-China economic conflicts, it is necessary to study the trade policies adopted by these countries in the years leading to the current situation. These policies include tariffs on imported goods, subsidies on exported goods, as well as policies related to foreign investment. Furthermore, using data published by international organizations, we will try to quantify the short-run and long-run economic effects of these recent trade wars on the economies of the two counties.

Carbohydrate Characterization in Traditional Chinese Medicine Using Rapid High-Throughout Mass Spectrometry-Based Methods

Ye Chen
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

Traditional Chinese Medicine (TCM) are herbal remedies that have long been used to treat diseases and health conditions. There has been significant recent interest in characterizing the chemical components. With the most prominent component of TCM being polysaccharides, many have shown pharmacological properties such as antitumor, antivirus, and anti-inflammatory. However, a major concern with TCM is the inability to characterize compounds such as polysaccharide due to the large diversity in monosaccharide compositions and glycosidic linkages present. Herein, we present the characterization of carbohydrates by elucidating the monosaccharide and glycosidic linkage compositions present in TCM using advanced liquid chromatography and mass spectrometry methods. In this study, 36 common TCM were lyophilized, bullet blended and incubated with water for complete homogenization. The samples were then derivatized and subjected to monosaccharide and glycosidic linkage analysis using Ultra-High-Performance Liquid Chromatography coupled with Triple Quadrupole Mass Spectrometry (UHPLC-QqQ MS). With this method, monosaccharide and linkage analyses were performed and the polysaccharide structures deduced for each TCM in the study. This research will provide a greater understanding of the role of polysaccharides in TCM and could lead to the mechanism of action as well as lead to new form of therapeutics.

Effects of Eye and Eyebrow Information on Emotion Recognition

Yu-Shih Chen
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Despite being the most communicative feature of human beings, emotions are not being applied while designing most of the current Human-Computer Interfaces; This is primarily due to the technical difficulty in accurately recognizing the emotional state of a person. Today, research techniques focus on facial expressions, speech patterns, and gesture movements to make inferences regarding a person's feelings. However, impracticalities of the current methods exist as there are physical and computational limitations to implementing the machine learning models that incorporate emotion recognition based on facial expressions, speech, or gestures. Recent studies show that our eyes and eyebrows dominate most of our communication of emotional states. Therefore, in this research, we propose to approach emotion recognition by training machine learning models only on the images of the eye and eyebrow. We extracted the eye and eyebrow portion of the existing datasets of facial expression images used to train current emotion recognition models, and we investigated the effect of the predictions made by Support Vector Machine, Convolutional Neural Networks, Boosted Decision Trees, and Hidden Markov Models. Our results suggested that this novel approach can be actively applied to conventional products to enhance the interaction of humans with computers based on emotions.

Infant Spatial Development in Puzzle Play

Audrey Chen
Sponsor: Lisa Oakes, Ph.D.
Psychology

Spatial abilities are important for effectively interacting with and perceiving objects in the world. One context in which we can see developmental change in young children's spatial abilities is during their puzzle play. Solving puzzles requires that children mentally and physically manipulating pieces to fit them into specific openings of a puzzle. We observed how children between 24 and 48 months (N = 70) insert a piece in a puzzle. Children were shown a puzzle with three empty differently shaped openings and one puzzle piece that fits in one of the openings. An experimenter pointed to each of the three openings and asked children which they thought the piece should go. Children were required to point to the openings that matched the puzzle piece. Then children were given the puzzle piece and asked to put the item in the appropriate spot. Although children overwhelmingly pointed to the correct spot, there was more variability in where they tried to insert the actual piece. By examining how long it took children to point to an opening, and how long it took them to insert the piece in the correct spot, we will have a better understanding of their developing understanding of spatial relations.

The Use of Stealth Peptide to Minimize Non-specific Binding of Target Protein During One Bead One Compound Combinatorial Library Screening

Ting Chia Chen
Sponsor: Kit Lam, Ph.D.
MED: Biochem & Molecular Med

One-bead-one-compound (OBOC) combinatorial method has proven to be a powerful tool for identifying bioactive molecules, including peptides, peptidomimetics, peptoids, and small molecules. However, recent studies have indicated that OBOC method is prone to produce false positives due to non-specific binding. Here we assessed the effects of stealth peptide comprised of tandem glutamic acid-lysine dipeptide sequences (Zwitterion), linkers, resins, and relative proportion of library compound and stealth peptide on the resin surface to develop a robust screening method for OBOC libraries, such that non-specific binding and false-positive binding can be minimized. We used bivalirudin (a known ligand against thrombin) as an example and screened the bead-bound peptide against thrombin. We hypothesize that OBOC libraries with optimized resin, linker, and optimized density of library compound and stealth peptide on the bead surface will greatly eliminate nonspecific binding, thus maximizing the chance of true-positive bead identification. Preliminary data indicated that the approach has worked well.

S1918 Phosphorylation is Critical for LTCC Activity Regulation During Enhanced angII Signaling

Hanyu Chen
Sponsor: Manuel Navedo, Ph.D.
MED: Pharmacology

Vascular smooth muscle cells in arteries contract or relax in response to stimuli to regulate blood flow. Calcium (Ca^{2+}) influx via voltage-gated L-type $Ca_V1.2$ channels (LTCC) is a major regulator of vascular smooth muscle contractility, and therefore blood flow and blood pressure in physiological and pathophysiological conditions such as hypertension. In hypertension (HTN), which is characterized by enhanced angiotensin II (ang II) signaling, evidence suggest that angII increase L-type $Ca_V1.2$ activity by activating Gq/PKC signaling. Yet, the precise activation mechanisms and its impact on vascular reactivity and hypertension are unknown. Previous findings have shown that the amino acid serine 1928 (S1928) is phosphorylated by protein kinase A (PKA) and is critical for LTCC regulation. We hypothesized that ang II-dependent phosphorylation of S1928 augments LTCC activity and vascular reactivity. Western blot analysis showed increase S1928 phosphorylation after angII treatment. This was correlated with increased LTCC activity in response to angII. Consistent with a key role for S1928 phosphorylation, in a mouse in which S1928 was mutated to alanine to prevent phosphorylation, we found that angII failed to induce an increase in LTCC activity. This data suggests that phosphorylation of S1928 is critical for regulation of LTCC activity during enhanced angII signaling.

Quantification of FD&C Red No.3 (Erythrosine) in Nutritional Drinks Marketed to Infants Comparing Regulations Between The EU & US

Mary-Ann Chen
Sponsor: Alyson Mitchell, Ph.D.
Food Science & Technology

Certified food dyes became grandfathered into food regulations through the Food, Drug, & Cosmetic Act (FD&C) as acceptable food additives. Over time, different FD&C days lost their safety certification through toxicity testing. Erythrosine is a xanthene dye which is a group of bright fluorescent dyes with the lowest threshold of acceptable daily intake (ADI). Erythrosine (FD&C Red No. 3) has an ADI of 2.5mg/kg/day for the US (FDA) and 0.1mg/kg/day for European Union (EFSA). Drink products, even nutritional drinks, are often found as the most consumed category of foods containing food dye when evaluating the market and infants are the highest risk population given their small size. Evaluating the levels of FD&C Red No. 3 using solid phase extraction (SPE) for isolation and high performance liquid chromatography (HPLC) with UV detection quantified levels in drinks marketed to infants. The levels ranged from 0.284 – 0.973 mg of dye per 1 full serving of nutritional drink marketed to infants. US FDA would report that this accounts for up to 3% of the ADI for an average two-year-old weighing 14kg if only one serving is consumed, while the EU (EFSA) would report that this accounts for 70% of the ADI same child.

Infants Use Prior Listening Experience to Support Word Learning

Ann Cheng
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

We investigated how infants take advantage of their early language listening experience to learn new words. We examined whether hearing speech sound sequences in an unfamiliar language helps infants learn new object names. Seventeen-month-old infants heard an artificial language made of four novel words for three minutes (e.g. golatu, tibudo, daropi, pabiku). One group (n = 22) saw two novel objects paired with two words from the artificial language (e.g. tibudo and pabiku) and another group (n = 22) heard labels that maintained the first and last syllables, but the middle syllable was replaced with the middle syllable of a different word (e.g. pabiku vs paroku). We hypothesized that when infants store detailed representations of words after listening to a stream of speech, they are more efficient at forming a mental connection between specific words and objects compared to infants without prior exposure. In contrast, infants who hear the changed labels do not have that support from the speech stream and will have difficulties learning new labels. Our results support statistical learning accounts of language acquisition that propose infants use prior listening experience with regularities in speech sound sequences to stimulate vocabulary learning.

Examining the Role of Calcium Oscillations in Human Eosinophil Phagocytosis

Yiting Chen
Sponsor: Volkmar Heinrich, Ph.D.
Biomedical Engineering

Eosinophils are a type of white blood cell that play a crucial role in the immune response to parasites and other pathogens. However, they are less studied than other immune cells, especially as it relates to their ability to engulf pathogens via phagocytosis. Here, we investigate eosinophil phagocytosis by measuring intracellular calcium, an important player in immune cell signaling, during one-on-one interactions between eosinophils and model pathogenic particles. We preload isolated eosinophils with a fluorescent calcium indicator and use a glass micropipette with controllable pressure to hold individual cells. We then use a second pipette to bring an antibody-coated bead into soft contact with the cell. Brightfield and fluorescence images are recorded for quantitative analysis of eosinophil morphology and calcium concentration over time. In all cases of phagocytosis, we observe a rapid burst in calcium concentration followed by repeated increases and decreases. Our data show that the first calcium burst either precedes or coincides with the start of phagocytosis. While the period of the apparent calcium oscillations is highly variable, the average time gap between peaks is ~30s. We are currently investigating if changes in cell shape or cortical tension correlate with variations in the calcium concentration.

Cross-species complementation of *Arabidopsis thaliana elf3* with Helianthus annuus homolog alleles

Ssu Chieh Cheng
Sponsor: Stacey Harmer, Ph.D.
Plant Biology

The plant circadian clock is an internal regulatory pathway that allows plants to adjust to and anticipate daily environmental alterations in temperature and sunlight. Common sunflower, Helianthus annuus, is an important crop plant with interesting circadian-regulated phenotypes such as daily timing of flowering and solar tracking. We have screened a mutagenized sunflower TILLING population for homologs of the core Arabidopsis thaliana circadian clock and have identified a mutant in EARLY FLOWERING 3 (ELF3). In Arabidopsis, ELF3 is an evening-expressed core circadian regulator; plant mutants for this gene exhibit early flowering, elongated hypocotyls, and arrhythmic circadian rhythms. Our preliminary studies have shown that sunflower elf3 exhibits late flowering and elongated hypocotyls, which are consistent with phenotypes observed in other species. Differential complementation of a loss-of-function mutant would provide evidence of functional differences between wild-type and elf3 sunflower alleles. However, due to insufficient biotechnology capabilities, molecular complementation in sunflower is currently impractical. We are therefore completing interspecies complementation of Arabidopsis elf3 mutants with sunflower homologs. We will be comparing wild-type and elf3-1 Arabidopsis plants to those complemented with wild-type and mutant alleles of sunflower ELF3 that are expressed under the control of the native Arabidopsis ELF3 promoter.

CaMKII and PLB Phosphorylation in a Novel GlcNacylation-Resistant (CaMKII S280A) Mouse

Sally Chesnut
Sponsor: Julie Bossuyt, D.V.M.,Ph.D.
MED: Pharmacology

Uncontrolled diabetes leads to hyperglycemia, a condition associated with cardiac dysfunction and increased arrhythmia risk. Higher activity of calcium/calmodulin-dependent protein kinase II (CaMKII) plays a crucial role in the development of these pathologies. We assessed if preventing CaMKII activation by O-GlcNacylation can limit the activation of CaMKII and its targets such as Phospholamban (PLB). Hereto, we used a knockin mouse model expressing O-GlcNacylation-resistant CaMKII (S280A). We then analyzed CaMKIIdelta expression and phosphorylation as well as that of its targets in the heart via Western Blot analysis. Quantification of the signals indicate that at baseline these S280A mice and their wild type littermates have no difference in the expression level or phosphorylation of CaMKII nor in that of the CaMKII target PLB. Further experiments examining the effect of hyperglycemia in these mice are ongoing. Our results suggest that these GlcNacylation-resistant CaMKII knock-in mice can be used to assess the contribution of CaMKII GlcNacylation in the development of cardiac pathologies under high glucose conditions. This tool will aid in understanding the role of CaMKIIdelta in diabetes.

Examining Pathogenicity of *Fusarium proliferatum* in Strawberry in California

Kuan Cheung
Sponsor: Thomas Gordon, Ph.D.
Plant Pathology

Fusarium is a large genus of fungi. Within the genus, there are species of Fusarium that have been proven to cause fungal diseases on plants. In 2019, Fusarium proliferatum was reported to cause vascular wilt on strawberry plants in Spain. Recently, wilt symptoms were observed in nursery strawberry plants (cultivars TYD-US-1025 and SVL-US-1105) in California, and two isolates of F.proliferatum were obtained from those plants. Then, hyphal single tips were obtained from the two isolates. To fulfill Koch's postulates, healthy strawberry plants for both cultivars were inoculated with both isolates with a spore suspension of 10^6 cfu/mL. Control plants were inoculated with sterile water agar. Plants are growing in a growth chamber at 30/26°C (day/night) with 12-h photoperiod. Ten weeks after inoculation, the severity of symptoms will be rated and plant tissue assays will be performed to confirm the colonization of the pathogen. If inoculated plants show wilt symptoms and we recover the fungus from those diseased plants, we can confirm that the two isolates are pathogens for strawberry plants.

Exploring Specialized Diterpenoid Metabolism in the Model Bioenergy Crop Switchgrass

Hui Wen Lisl Chew
Sponsor: Philipp Zerbe, Ph.D.
Plant Biology

Switchgrass is a leading model bioenergy crop with high biomass yields and strong resilience to abiotic and biotic stressors. However, global climate change is predicted to magnify environmental pressures, threatening renewable crop-based bioenergy production. Other major monocot crops mount a complex diterpenoid defense response under environmental stress. Therefore, we hypothesize that switchgrass plants utilize specialized diterpenoids for enhanced stress tolerance. Previously, we characterized 13 diterpene synthases (diTPS) in switchgrass that produce an array of diterpene scaffolds. Based on observations in rice and maize, we predicted these compounds could be further modified by cytochrome P450 monooxygenases (CYP) to produce biologically relevant metabolites. We recently identified two CYP701A genes with predicted functions in primary and specialized terpene metabolism. Combinatorial co-expression assays in E. coli pairing each P450 with a diTPS scaffold resulted in the formation of ent-kaurenoic acid by CYP701A1, the first step in gibberellic acid biosynthesis, and a putative hydroxylated product from the syn-pimara-9(11)-15-diene scaffold by CYP701A2. Similar enzymatic steps to CYP701A2 were observed in rice in the production of inducible defensive momilactones, suggesting similar compounds may be present in switchgrass. Further elucidation of diterpene biochemical pathways in switchgrass may provide a deeper understanding of monocot stress resilience mechanisms.

The Truth Behind the Words: Educating the Public What to Believe about Animal Science

Yunhee Cho
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

With its accessibility for various contents, internet has become an essential source of information. However, the rapid development and spread of the internet also have caused an atmosphere where people are constantly exposed to misinformation and fake news. While a popular means of exchanging results among science communities and academics are mostly through peer reviewed journals, various technological and communicative advancements, such as news, videos, and social media platforms, have allowed interdisciplinary communications available to general audiences. With general public's unfamiliarity in scientific literatures, the mass media has a significant impact on people building wrong perceptions of this field, especially in animal science (Hunter, 2016). This paper will discuss the effect of expansion of misinformation by writings online in this discipline on the public through survey of UC Davis students and case studies of media. The aim of this research is to inform the public about the impact of social media on people's stereotypic perspectives on science and ultimately to improve the public understanding of animal, agricultural, and environmental sciences.

The Impact of Food Insecurity and Food Label Use on Calories Purchased

Lauren Christie
Sponsor: Lisa Miller, Ph.D.
Human Ecology

Socioeconomic class is a major contributor to food insecurity, the condition of limited or uncertain access to nutritionally sufficient food. Food insecurity among students is related to increased stress, lower GPA, and poor health outcomes. Little is known about shopping behaviors of food insecure students and the extent to which they use food labels. Our project explored the effects of food security and ingredient label use on calories purchased during an online shopping task. Students (n=48) completed a survey and shopped online to hypothetically purchase 8 items for a 4-person meal while staying within a given budget. Results showed that ingredient list use had a differential impact on calories (per dollar spent) for food secure vs food insecure students. For food secure students, label use reduced calories purchased; however, for food insecure students, label use had no impact on calories purchased. Given that lower calories most often reflect healthier choices, the findings could indicate that food insecure students use ingredient lists less effectively. Understanding potential barriers to healthy food choices among food insecure students may inform interventions needed to promote nutrition literacy and healthier food purchases.

Exploring MutY Target Recognition of Damaged DNA

Ellen Chu
Sponsor: Sheila David, Ph.D.
Chemistry

DNA repair enzymes are essential for the survival of aerobic organisms by maintaining and repairing damaged DNA. Humans are thus fortunate to have base excision repair (BER) enzymes in their cells like MutY, an enzyme which removes adenine DNA bases. My research focuses on 8-oxo-2'-deoxyguanosine (8-OG) because I am interested in understanding the structural features of the resulting 8-OG:A mispair that enables MutY mediated recognition and repair. Prior work from our lab showed that the 2-amino of 8-OG was critical for repair by MutY in a cellular context. This revealed the necessity of the 2-amino in MutY recognition of 8-OG:A. Now we are asking the question: what about the 2-amino enables MutY recognition? My research involves the synthesis of analogs of 8-OG modified at the 2-position, such as 2-Br-8-oxo-2'-deoxyinosine and other 2-modified oligonucleotides, to understand the properties of the 2-amino of 8-OG that enable MutY target recognition. We want to determine the extent of hydrogen bonding and steric effects imparted by the 2-amino on MutY. This research will further our understanding of the critical DNA repair enzyme MutY, which has been linked to the onset and progression of colorectal cancer.

The Middle East and North Africa in US Media Representations: An Analysis of the Term "Syrian Orthodox" in the New York Times (1900-1909)

Kymberley Chu
Sponsor: Suad Joseph, Ph.D.
Anthropology

I aim to analyze the New York Times (NYT) articles between the years of 1900-1909 that contain the term "Syrian Orthodox". I researched relevant articles using the ProQuest Historical Newspaper database searching for the term "Syrian Orthodox". During my research, I examined 30 articles and analyzed six critically relevant articles. I found that there is a negative consistent depiction of representing the Syrian Orthodox clergy in Brooklyn, New York as provocative. This NYT media trend portrays the Syrian Orthodox clergy as instigating physical acts of violence between different Syrian diaspora groups. Referring to Edward Said's Orientalism discourse, I argue that the NYT media representation of the Syrian Orthodox diaspora in Brooklyn is socially significant due to suggesting the alienation and the cultural outsider status of the Syrian Orthodox clergy, unable to be categorized like "Anglo-American" Christians. This research is part of a larger project analyzing 150 years of the liberal-leaning New York Times articles in the Dr. Suad Joseph Lab.

Cyclic Heat Stress on Multiple Generations of Japanese Quail Results in Lipid Peroxidation of Egg Yolk

Anali Cine Garcia
Sponsor: Annie King, Ph.D.
Animal Science

Previous results showed that heat stress can lead to undesirable egg quality, nutritional value, yolk color, and shell life. More specifically, heat stress promotes yolk lipid peroxidation, thus, leading to high levels of malondialdehyde (MDA), commonly used as a marker of oxidative stress. MDA is associated with low nutritional value and unfavorable taste. To determine the effect of multigenerational cyclic heat stress in Japanese quail (Coturnix japonica), MDA levels in quail egg yolk were quantified after 9 generations of cyclic heat stress. Eggs were collected for 2 weeks. Treatments were heat stressed (HS), heat stressed siblings (HSS), non-heat stressed (C), and non-heat stressed siblings (NHSS). The thiobarbituric acid reactive substances assay was used to measure MDA levels. Significance was determined at $P = 0.05$. Results showed no significant difference between treatments in week 1. However, there was a significant difference between treatments in week 2. Although not significant, heat stressed treatments had numerically higher MDA levels, overall. This finding is important to producers and consumers because results indicated lipid oxidation in egg yolk after multiple generations of heat stress. Due to storage concerns, future research will include analysis of MDA levels in eggs that were laid within 24 hours of analysis.

Positivity Bias in Verbal Episodic Memory for Native versus Non-Native Speakers

Rowen Clayton
Sponsor: Beth Ober, Ph.D.
Human Ecology

In prior experiments, our lab investigated potential differences in positivity bias for young-adult native English speakers (E1) vs. non-native speakers (E2). Across three verbal learning and memory experiments, we have obtained a significant language-related positivity effect (i.e., language x valence interaction), due to E2 speakers showing greater memory advantage for positive versus negative English words. In prior studies, each subject was given one long, mixed list of positive and negative words, from several semantic categories. The main purpose of the current study was to determine whether our language-related positivity effect would be replicated with a different type of list-learning paradigm, involving the learning of associations between meaningless symbols and five-word lists. Each "mini-list" was either positive, negative, or neutral, and contained either category co-members or unrelated words. Using this paradigm, we specifically aim to assess E1-E2 differences in: (a) positive versus neutral, as well as negative versus neutral, word recall; (b) modulation of valence effects by categorized versus unrelated word lists; and (c) valence versus category clustering for the overall, delayed, free recall trial. Data collection is ongoing; our poster will showcase preliminary findings.

Biological Control of Fusarium Wilt in Strawberries Using *Trichoderma asperellum*

Benjamin Cohen Stillman
Sponsor: Ana maria Pastrana Leon, Ph.D.
Plant Pathology

Fusarium wilt, caused by the soil-borne fungal pathogen Fusarium oxysporum f. sp. fragariae (Fof), is an important disease of strawberries leading to stunting, discoloration, and often plant death. In California, where 80% of US strawberries are grown, Fof is present in all major growing regions. As regulators have restricted the use of chemical soil fumigants traditionally used to manage Fof incidence, alternative control methods have received increased attention. Trichoderma spp. have been shown to mitigate the effects of many soil-borne fungal diseases, including those caused by Fusarium spp. In this study, a commercially available preparation of Trichoderma asperellum was used to investigate its effects on Fusarium wilt in strawberries. In-pot treatments were prepared using sand inoculated with Fof and T. asperellum -treated potting soil. Another treatment was prepared using Fof inoculated sand and plants treated with a chemical fungicide, which was compared to positive and negative controls for both Fof and T. asperellum. After 10-12 weeks, strawberry plants in in-pot tests will be weighed to determine disease impact on biomass, and virulence will be rated on a semi-continuous scale based on severity of symptoms. In-vitro studies of the effects of T. asperellum on Fof may also be carried out.

Development of a Novel Propulsive Lunar Mobility and Lunar Gravity Emulating Platform

Cordell Cohoon
Sponsor: Stephen Robinson,
Department of Mechanical and Aerospace Engineering

This presentation discusses the system design and concept of operations of the Lunar Emulated Hopper Platform (LEHoP), an Earth-based testbed for lunar mobility systems designed for NASA's BIG Idea Challenge 2020. With NASA putting humans back on the Moon by 2024, lunar surface exploration represents a critical component of lunar infrastructure due to necessary tasks such as locating water ice deposits. Due to these deposits most commonly occurring in the rough terrain of the permanently-shadowed regions of large craters, land rovers face significant mobility challenges and thus alternate transportation methods may be preferable. Our approach consists of a propulsive "hopping" device that ejects warm gas to enter flight, traverse terrain, and land while carrying small scientific payloads. The propulsive system utilizes unique, medium flow-rate resistojet thrusters and a ducted fan apparatus which emulates lunar gravity on Earth. Successful development of such a platform could lead to the generation of best-practices in hopper design, which would benefit future lunar exploration endeavors.

Transcript Validation for a Novel Androgen Receptor Variant, BI-V1, in Bladder Cancer

Rachel Collier
Sponsor: Maria Mudryj, Ph.D.
MED: Medical Microbiology & Imm

Bladder cancer is the sixth most commonly diagnosed cancer worldwide, with three out of four new cases occurring in men. A potential reason for this gender disparity is the androgen receptor (AR), a ligand-dependent transcriptional factor that binds androgens, mainly testosterone and its metabolite 5alpha-dihydrotestosterone (DHT). Androgens function in a DNA dependent manner to regulate target genes at the transcriptional level. Some tumor cancer models, however, have an increase in AR splice variants, a regulated process during gene expression that results in a single gene coding for multiple proteins. Some of these variants lack a ligand binding domain, but can still bind to DNA and activate transcription. We have isolated and characterized a mutated AR variant, BI-V1, in human bladder cancer cell lines. In previous studies, RNA-seq was used to identify transcript changes of the AR-dependent transcriptome by depleting total AR BI-V1 and overexpressing BI-V1 in UM-UC-3 cells. This study verifies those specific RNA-seq transcripts through qPCR of AR and BI-V1 knockdowns in UM-UC-3 bladder cell lines.

Efficacy of Stripping Buffers for Nitrocellulose Membrane Western Blot Strip Reuse

Liam Condon
Sponsor: Aldrin Gomes, Ph.D.
MED: Physiology & Membrane Biol

Western Blotting is an effective technique that allows researchers to obtain a relative measurement of a certain protein's concentration in a sample. Previous studies suggest stripping buffers can be used for reuse of Western Blot strips by removing antibodies from their binding site on a target protein while leaving the protein undisturbed. In this study we aim to understand the effects of a stripping buffer on the protein concentration of a Western Blot. This buffer utilizes a low pH to strip away the antibodies. For our western blots I used rat heart samples and nitrocellulose membranes with a proteasome subunit alpha type 6 (PSMA6) primary antibody. Using the stripping buffer, we then stripped the blots and probed them again with PSMA6. Using a control blot that was not exposed to the stripping buffer we can compare their relative protein concentrations. Our hypothesis is that the stripping buffer will remove some of the protein, in addition to the antibodies, from the nitrocellulose membrane. Our results suggest the stripping buffer did not affect protein concentration.

Supersize Me: The Effects of Anthropogenic Food Sources on Different Gull Species

Matthew Conner
Sponsor: Joshua Hull, Ph.D.
Animal Science

Humans are having a multitude of effects on wildlife around the world, some may be positive and some negative. The goal of this project is to investigate the effects of anthropogenic waste as food sources on short and long term fitness in various gull species. We can then use this system and species as a model for how our disposal system affects, not only bird species, but all organism's health and wellness. Diet and fitness data were collected and summarized from research on different gull populations and analyzed based on the species of gull, the proximity of a population to an urban center, and reproductive success. The initial results of this study may suggest that there are negative health effects on individuals but nutrient subsidies from anthropogenic sources are having an overall positive effect on gull population size. This research can be expanded to management strategies on how to deal with fluctuating gull populations, as well as, provide insight into policies for trash disposal methods.

Testing Reproducibility of a Maternal Immune Activation Model Through the Assessment of Developmental Neuroanatomy in Offspring

Emma Connolly
Sponsor: Alexander Nord, Ph.D.
MED: Psychiatry & Behav Sci

Maternal immune activation (MIA) has emerged as one of the key environmental risk factors for neurodevelopmental disorders (NDD), including autism and schizophrenia. Animal models of MIA provide the opportunity to identify the molecular signaling pathways that initiate the disease process and lead to NDD-related neuropathology. We've recently applied transcriptional profiling in a developmental time course following MIA induction via poly(I:C) injection at 12.5 days post-conception. Using immunohistochemistry to validate transcriptional signatures at the protein level, we found that MIA causes altered developmental pathways in brain development with most altered signatures detected by E14.5 and peaking at E17.5. Due to the nature of working with environmental animal models, reproducibility is crucial to ensure rigor and reflect the findings of a valid experiment. Here, I assess the reproducibility of our model in a second cohort of mice obtained 2 years after the original study by testing the initial neuroanatomy findings. Using immunohistochemistry, I analyzed proliferation and differentiation changes at E17.5 in both control and MIA embryos, blinded to experimental conditions. My results reaffirm the importance of maintaining unaltered conditions and variables for research reproducibility, a crucial fact that is often overlooked when working with environmental models.

Functional Characterization of Multiple Myeloma GWAS Risk Variants in African American Cell Lines via Scarless CRISPR/Cas9 Genome Editing

Marisol Contreras Cervantes
Sponsor: Luis Carvajal-Carmona, Ph.D.
MED: Biochem & Molecular Med

Multiple Myeloma (MM) is malignancy of the plasma cells that accounts for 20% of all hematological cancer deaths in the US. Currently, an important health disparity exists in African Americans (AA), who are twice more likely to be diagnosed with MM compared to individuals of White ancestry. MM risk is partly determined by genetic predisposition. Genome-Wide Association Studies (GWAS) have identified16 MM loci. Two of these, rs6877329 and rs4487645 demonstrated functionality in MM development via regulation of ELL2 and CDC7AL expression, however, these functions are not confirmed in AAs. Our lab combines scarless CRISPR/Cas9 homology-directed repair genome editing and Kompetitive Allele Specific PCR (KASP) to generate isogenic cell lines that model single base variants. Applying this method to rs6877329 and rs4487645 in MM.1S and MM.1R cells, MM cell lines derived from the same AA patient, we will assess allele-specific modulation of gene expression as well as measure the effects of risk status on MM cell viability and proliferation. Our study represents one of the first to generate functional data in race-appropriate models for MM GWAS risk SNPs to date and is an important step towards understanding the genetic component of MM susceptibility for improving disparities for MM in the US.

Elucidating Molecular Cues that Guide Subtype-specific Synaptogenesisin the Retinal Direction-selective Circuit

Karen Cornejo
Sponsor: Lynne Arcangel, M.A.
Graduate Division

Direction selectivity is a property of a subset of neurons in the retina, called direction-selective retinal ganglion cells (DSGCs). DSGCs are activated by objects moving in one preferred direction of the visual field but are silent when thatsame object moves in the opposite direction. This asymmetric property of DSGCs is due to asymmetric wiring of an inhibitory neuron, called a starburst amacrine cells(SACs). Recent studies have demonstrated that DSGCs with a specific directional preference receive inhibitory inputs from a subset of SAC processes that are oriented parallel to their preferred direction. However, the molecular basis of thisspecificity of synapses remains unknown. The purpose of this project is to identify candidate proteins that differ in expression among the 3 subtypes of DSGCs,each of which has a different preferred direction. To address this question, we used RNA sequencing from isolated DSGC populations tuned for either nasal or ventral motion to find differences in gene expression. We then implemented in situhybridization to evaluate the localization of these molecular cues in the retina. This work in the retina can serve as a model to decipher the molecular code involved in precise synaptic wiring throughout the central nervous system.

Au Crépuscule Dans la Langue Sylvestre

Grant Cottier
Sponsor: Laurie San Martin, Ph.D.
Music

Inspired by a recent trip to France, this piece pays homage to some of the rich and diverse musical styles which developed there over the course of the 20th Century and have come to heavily influence my style of composition. The first movement is a pensive spectral exploration of the harmonic spectrum produced by a harp, much in the tradition of Gérard Grisey and Tristan Murail. The second movement looks next to impressionism for influence; it is very loosely based on the opening thematic material from Claude Debussy's iconic and groundbreaking sonata for flute, viola, and harp. Befitting these impressionist influence, this movement abounds with rich, extended harmonies throughout. The third and final movement, which unfolds attacca from the second via a sustained bisbigliando in the harp, combines tenets of the two aforementioned musical styles, incorporating compositional methods and thematic material alike from both traditions into a single piece of music.

The Middle East and North Africa in U.S. Media Representations: An Analysis of the Term "Jewish" in the New York Times (1900-1909)

Sarah Covault
Sponsor: Suad Joseph, Ph.D.
Anthropology

My research is focused on analyzing the New York Times' representation of the Middle East from 1900 to 1909. 491 articles out of 5,696 in which the term "Jewish" was used have been searched for relevance. Of those 491 articles, I have analyzed 11 for their relevance to the term. From my research, I have found two important trends surrounding the term "Jewish." The first being the focus on Jewish refugees migrating to the US and the subsequent plethora of issues they face, which leads into the second trend. The rise of Zionism was also a prevalent topic at this time, and many of the articles in which this appeared discussed the demographic that lent itself to Zionism, many of whom were Jewish refugees. As many articles have mentioned, the Jewish diaspora, which is noticeably seen throughout these articles, was one of the main reasons for the creation of the state of Israel. Examining this trend in the New York Times is important, as the period of 1900 to 1909 showed movement towards Zionism. This research is part of a larger analytical project of the New York Times over 150 years conducted in Dr. Suad Joseph's lab in Anthropology.

Associations of Children's Hair Cortisol with Perceived Stress and Anxiety

Hollie Crandell
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

Perceived stress and anxiety have the potential to negatively impact children's lives. However, we currently lack reliable biomarkers that could indicate whether children have been exposed to high levels of stress and anxiety over long periods of time. A recent methodology for assessing cumulative stress exposure is the assay of the stress hormone cortisol in human hair samples. To date, there is limited research on the utility of this biomarker in children. The present study aimed to address this gap. In this study, we examined the extent to which hair cortisol levels correlate with children's perceived stress as well as their reported state and trait anxiety. A total of 182 participants aged 9-11 years old attended a laboratory visit, provided a 3cm (10mg) hair sample that was cut at the root, and completed the Perceived Stress Scale and the State-Trait Anxiety Inventory questionnaires. We will present analyses examining correlations among hair cortisol, perceived stress, and state and trait anxiety in children.

Group Testing as a Method for Assessing Consistent Individual Differences in Ewes

Lauren Cromwell
Sponsor: Kristina Horback, Ph.D.
Animal Science

Consistent individual differences are defined as coherent behavioral and physiological responses evoked during stressful events while still maintaining temporal and contextual stability. Previous studies have investigated these differences by testing isolated sheep, however, this may induce the motivation to seek conspecific reinforcement and in-turn, interfere with the response to the intended experimental stimulus. The purpose of this study is to investigate if individual characteristics of sheep can still be identified through group testing. Our objectives are to 1.) assess salient behavioral responses that may represent a trait within individual testing and in group testing, and 2.) evaluate the relationship of discernable traits between individual and group testing through principal component analysis. This study subjected 22 multiparous, crossbred ewes (Suffolk, Rambouillet, and Polypay), housed at the UC Davis Sheep Barn, to individual and group testing (4-5 individuals/test) over a period of 6 weeks. The individuals and groups were tested in a 16 x16 ft gridded arena, partitioned by 4x4 painted squares with a human in the center. Behavioral data is currently being coded using Noldus the ObserverÂ® XT program. Inter-rater reliability of behavioral data will be ascertained before data analysis (Intra-class coefficient >0.80).

Group Testing as a Method for Assessing Consistent Individual Differences in Ewes

Erika Cromwell
Sponsor: Kristina Horback, Ph.D.
Animal Science

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Oral History Project: Gurase Bhume Aama Samuha Museum

Jordan Crowley
Sponsor: Nancy Erbstein, Ph.D.
Education

In Macchapucchre Village, Nepal, infrastructure and lifestyles have changed dramatically in recent decades. There is growing local concern that cultural traditions are fading and historical knowledge is being lost, especially amongst youth. In 2010, the local Aama Samuha (Mother's Group) of the Gurung ethnic community constructed a multi-room building, built shelving, and collected cultural artifacts. As of 2019, the museum was still in an early phase of development. The interdisciplinary 2019 Oral History Project Team, comprised of UC Davis and Nepali students, was asked to assist with research activity. Meetings with Aama Samuha revealed that historical documentation and generational gaps were primary concerns. In response, our team collected oral histories about physical artifacts, local festivals, and personal life stories by employing a participatory model in which the needs of the local elders guided the research. Informed by a combination of photo sessions and interviews, we developed a bilingual catalogue of 86 artifacts which facilitated thematic reorganization of the museum shelves. The multimedia documentation of our conversations and creation of a Facebook page improve media outreach and youth engagement. Our documentation provides context and provokes questions for further investigation into Macchapucchre Village's history, culture, and residents' stories.

What Makes for an Inclusive STEM Classroom? Students' Perspectives

Bianca-Yesenia Cruz Aguayo
Sponsor: Natalia Caporale, Ph.D.
Neuro Physio & Behavior

Institutional and classroom environments play a key role in promoting retention and eventual graduation of students in science, technology, engineering and mathematics (STEM) fields. Despite its importance, there is little consensus as to what inclusiveness in Higher Education looks like and what it entails. To develop programs and interventions that can improve classroom climates for all students, it is critical to identify the factors that students think are important when it comes to feeling included. The purpose of this study was to gain insight on the perspective of students about what makes a classroom inclusive. We surveyed students in an upper division STEM course in the College of Biological Sciences. Students were asked the question: "In your opinion, what does an inclusive class look and feel like? Please be specific." Student's answers were coded using a grounded theory approach into the following six categories, (each with one of more subcategories) based on the common themes that were found: class climate, student diversity, equity, instructional practices, infrastructure, and instructor immediacy. Understanding how students perceive and conceptualize inclusion will aid in the development of classroom practices and environments that can promote feelings of inclusion and through this, retention of students in STEM.

The Role of Inter-sister Recombination when Spermatogenesis is Perturbed in *Caenorhabditis elegans*

Lorena Cruz-Gutierrez
Sponsor: Joanne Engebrecht, Ph.D.
Molecular & Cellular Bio

In meiosis, DNA double strand breaks (DSBs) are intentionally induced by the topoisomerase SPO-11. Some DSBs form inter-homolog crossovers that promote the accurate segregation of chromosomes, but most are repaired through alternative pathways such as inter-sister recombination. Inter-sister recombination utilizes the sister chromatid to repair DSBs, does not result in crossovers, and thus, does not promote chromosome segregation. However, when homologous chromosomes fail to pair and synapse, this pathway is likely to play an important role in meiotic DSB repair. Preliminary evidence leads us to hypothesize that when C. elegans spermatogenesis is perturbed, there are elevated DSBs that are repaired through inter-sister recombination. Using GFP::COSA-1, a marker for inter-homolog crossover precursors, I am analyzing the consequence of mutating the Structural Maintenance of Chromosomes (SMC) 5/6 Protein Complex, which functions in chromosome segregation, replication, and repair, particularly in the absence of ZIM-1 and ZIM-2, where certain chromosomes fail to pair and synapse. If inter-sister recombination is the predominant repair pathway, we expect to see elevated numbers of GFP::COSA-1 in the smc-5/6 mutant males when a subset of chromosomes fail to pair and synapse because the pathway is blocked, aberrantly channeling repair through the inter-homolog pathway.

MGH3 is not Required for Sperm Nuclei Condensation in Rice

Binyu Cui
Sponsor: Venkatesan Sundaresan, Ph.D.
Plant Biology

Histone is a major part of the eukaryotic nucleosome, which DNA wraps around. Histone proteins regulate transcription activity. Histone 3 (H3), one of the histone octamer subunits, includes several variants, all of which contain a highly conserved core and a variable N-terminal tail. One of the H3 variants, H3.10 or MGH3, expresses specifically in sperm cells with high expression level. Recent research suggested that male-gamete-specific histone H3 (MGH3) is responsible for sperm chromatin condensation, and that if it is mutated, could result in larger sperm nuclei. In this study, we used CRISPR/Cas9 to knock-out MGH3 in rice. We identified frame shift mutants in the M2 generation that the transgene was also segregated away. The frame shift mutants were fully fertile for three generations. We used DAPI to stain pollen and sperm cell nuclei. ImageJ was used to quantify the size of cells/nuclei from hundreds of microscope images. Statistical analyses showed that there was no significant increment on the relative size of sperm nuclei in MGH3 mutants, suggesting that MGH3 is not required for sperm nuclei condensation in rice.

Ecological and Edible Playgrounds: How a Landscape Design for an Outdoor Play Space at a Child Development Center in Sacramento can Provide Food for Children and Habitat for Pollinators

Colette Curran
Sponsor: Anna Kiers, M.L.A.
Human Ecology

Children in urban areas are often disconnected from nature and the food that they eat. Outdoor landscapes that are designed for children have become increasingly commercialized and often lack ecological value and features that connect children to nature. Meanwhile, many children in cities do not have access to locally grown produce. In order to address these problems, people are creating more play spaces that have ecological value and edible plants. One site that has the potential to reconnect children with nature and food is the outdoor play space at the future Child Development Center (CDC) at the University of California, Davis Sacramento campus. The research question that this project investigates is “How can underutilized spaces at the CDC be transformed into places that provide food for children and habitat for pollinators?” Methods that were used to answer this question include literature reviews, case studies, interviews, and data analysis. This study concludes that the proposed outdoor play space at the CDC can provide food for children, increase pollinator habitat, and connect children with nature by implementing a design that includes regionally appropriate edible plants, features Central Valley native pollinator plants, and encourages children to interact with the landscape.

Examining the Relation Between Socioeconomic Status and Hair Cortisol Concentrations

Austin Dalmasso
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

Cortisol is an endogenous steroid hormone regulated by the hypothalamic-pituitary-adrenal (HPA) axis. The HPA axis is the human body’s primary system for processing and responding to stress and, among other functions, is responsible for modulating cortisol levels in the body. Acute stress responses are often measured in salivary, blood, or urinary cortisol levels and chronic stress responses are garnered from analysis of hair cortisol concentrations (HCC). Scalp hair grows at an average of one centimeter a month so through the collection of three centimeters of hair from the posterior vertex (“crown”) of the head we can estimate participants cumulative exposure to stress over the past three months. Examples of chronic stressors include prolonged exposure to systemic racism, discrimination, housing/food insecurity, etc. Through a composite analysis of indicators and proxies of socioeconomic status (SES) and HCC, we will examine the correlation between chronic stress and SES. We will discuss implications for intervention and policy.

Examining the Effects of the NMDA Receptor Co-Agonist D-Serine on Inhibitory Hippocampal Synapses

Emily Daly
Sponsor: John Gray, M.D.,Ph.D.
MED: Neurology

A precise balance of inhibitory and excitatory synapses onto neurons is very critical for proper brain function. For this project, we are examining inhibitory synapses onto excitatory pyramidal neurons in the hippocampus, a region of the brain responsible for learning and memory. Preliminary findings using electrophysiology suggest an approximately 50% decrease in the number of inhibitory synapses in the hippocampus of mice lacking the serine racemase enzyme, which converts L-serine to D-serine, a co-agonist of NMDA receptors. These receptors play crucial roles in neurodevelopment and synaptic plasticity and hypofunction of NMDA receptors has been implicated in schizophrenia. We will be comparing images of sections taken from adult male control and serine racemase knock-out mice. Using immunohistochemistry, we plan to label inhibitory presynaptic terminals by staining the hippocampus with antibodies against syt-2 and VGAT, and to examine the levels and distribution of these proteins to determine if there is a change in the amount of inhibitory synapses in the hippocampus. These experiments will strengthen our understanding of how NMDA receptor co-agonists affect synaptic development and neuronal function.

Characterization and Evaluation of Vascular Injury in a Porcine Ischemia-Reperfusion Model

An Dang
Sponsor: Ian Brown, M.D.,Ph.D.
MED: Surgery

Ischemia–reperfusion injury occurs when perfusion is restored to the tissue after a period of ischemic events. Despite the benefit of preventing tissue necrosis, reperfusion can trigger additional tissue injury through inflammation and thrombosis. In our study, the porcine model relevant to resuscitative endovascular balloon occlusion of the aorta (REBOA), a hemorrhage-control technique involving occlusion of the aorta that can induce reperfusion injury. The goal of this project was to identify vascular injury and characterize its features to develop a consistent histopathological scoring system. To localize injury in the vasculature, paraffin-embedded abdominal-aorta tissue sections from treatment group and sham pigs were stained with the immunofluorescent intercellular adhesion molecule, ICAM-1, and the immunofluorescent fibrin. Immunofluorescent staining with ICAM-1 demonstrated the presence of proinflammatory effects such as potential inflammatory leukocyte recruitment. The quantification of immunofluorescent fibrin accumulation allows us to deduce the likelihood of thrombotic formation. Our histopathological scoring system is based on typical vascular injury features such as increased expression of endothelial cell adhesion molecules and increased expression of thrombosis-inducing fibrin. This scoring system will allow us to identify vascular injury and ultimately guide our investigation of the mechanisms behind ischemia-reperfusion injury in the REBOA model.

Study of Copper Gallium Selenide Photocatalyst Using Surface Photovoltage Spectroscopy

Nhu Dang
Sponsor: Frank Osterloh, Ph.D.
Chemistry

Copper Gallium Selenide (CGSe) is a promising photocatalyst for the sunlight-driven water-splitting reaction, a pathway to renewable hydrogen fuel. To study photochemical charge separation in CGSe films, surface photovoltage spectroscopy (SPS) was used to measure the photopotential across sample films (773 to 1245 nm) made by the drop-casting method. These films were also used to study the effect of surface modification with Na_2S on photovoltage magnitude. Other aspects, including annealing temperature, type of substrate, and the use of sacrificial reagents were investigated to understand more about the charge-transfer process. While the surface treatment with Na_2S fails to produce a significant change in the photovoltage and the reversibility, substrate choice and annealing temperature show critical impacts. Also, it is found that fluorine-doped tin oxide (FTO) substrate produces larger signal compared to indium-doped tin oxide (ITO) and gold (Au), and that 600°C is the best temperature to anneal FTO films.

Effects of Phagocyte Derived Respiratory Bursts on *Clostridia* Population in the Gut During Salmonella Typhimurium Infection

Shenhav David
Sponsor: Andreas Baumler, Ph.D.
MED: Medical Microbiology & Imm

The human gut is populated with diverse classes of anaerobic bacteria, such as Clostridia, which primarily break down complex sugars for the host. Previous work has shown Clostridia does not only provide the host with nutrients, but it can also limit the expansion of pathogens in the gut. We found that Salmonella Typhimurium infection depletes the Clostridia population in the gut, but the mechanisms which promote this phenomenon are largely unknown. During an infection, Salmonella Typhimurium stimulates the host immune response and causes the release of reactive oxygen and nitrogen species in the colon. Although these host defenses are intended to eliminate Salmonella, Salmonella is able to use byproducts from these respiratory bursts as terminal electrons acceptors to survive, while Clostridia cannot. We hypothesize that these respiratory bursts play a key role in Clostridia depletion. By disrupting the release of radical species with chemical inhibitors, we can reveal the role of phagocyte derived respiratory bursts response during Salmonella outgrowth. Understanding the mechanisms Salmonella Typhimurium uses to deplete the Clostridia population in the host gut will advance our knowledge of how disruptions of microbial homeostasis lead to colitis. These results also help recognize universal mechanisms that drive other models of colitis.

Phenotypic Traits of Plantago lanceolata as Related to Density and Demography

Carmen David
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

This project is a continuation of a study on the globally-distributed perennial plant Plantago lanceolata that has been conducted annually since 2016. This study uses the protocol of Plant Pop Net, an international project, which aims to understand the factors driving the spatial dynamics of plant populations in response to climate change using data from P. lanceolata populations around the world. At our site in Davis, CA, we measured the abundance and phenotypic traits of P. lanceolata for four years. The trait data includes floral characteristics, phenology, morphology, and signs of herbivory. Using this data, we want to investigate leaf area as a measurement of plant size as well as compared to rosette density. We would like to explore what affects plant size and density have on survival and reproduction. In previous years, we have found relationships between plant size and density to be significant. We would like to further examine these relationships through comparison with past data from our site.

Appreciation of the Ephemeral: A Floral Sculpture

Gina Davis
Sponsor: Jennifer Cadieux, M.F.A.
Department Of Design

In classical art, the arrangements of flowers are inconspicuous stories on the canvas. My research on the symbolism of florals within Renaissance paintings will manifest in a temporary sculpture, responding with immediacy to the fleeting life of the flowers and moreover the fleeting moments of experiencing it. Traditionally, florals have been represented in paintings but I would like to explore a practice with their organic form. The dynamic sculpture will integrate a variety of colors, shapes, and sized flowers sourced from the UC Davis Student Farm. The design will be open to interpretation, allowing the viewer to create their own story and appreciate its vibrant ephemeral beauty. My goal is to shift the way we can engage with temporary art. Contemporary life consists of busy schedules and dwindling opportunities for introspection. This project proposes immediacy and appreciation, taking in the life of the florals and the life in the moment. The form will be inspired by traditional column, thus allowing it to be viewed from all sides. Flowers hold a beautiful reservation that can only be appreciated in a timely manner, and so, it must be showcased.

Differential $K_{Ca}3.1$ Potassium Channel Expression Between Two Rodent Models of Acute Neuroinflammatory Insults

Tryssa De Ruyter
Sponsor: Pamela Lein, Ph.D.
VM: Molecular Bio Sciences

The aim of this project was to determine if microglia express fewer $K_{Ca}3.1$ potassium channels in adult male Sprague-Dawley rats following diisopropylfluorophosphate (DFP)-induced status epilepticus (SE) than after middle cerebral artery occlusion (MCAO)-model of ischemic stroke. Persistent microglial activation following acute OP intoxication is a possible disease mechanism, with no currently effective therapies. Animal models of ischemic stroke show similar microglial activation but respond to pharmacological inhibitors, leading us to compare microglial activation profiles in these two models. Animals were euthanized at 1, 3, 7 or 28 days following experimental procedures, and brains were prepared for immunohistochemical analysis of IBA-1 and $K_{Ca}3.1$ markers. Our analyses confirmed MCAO animals had greater numbers of $K_{Ca}3.1$ positive microglial cells in the infarct than contralateral region at 3 days. Numbers of $K_{Ca}3.1$ cells in the cortex and thalamus of DFP animals was greater than MCAO animals at 3 and 28 days. However, the number of IBA-1 cells that expressed $K_{Ca}3.1$ was lower in DFP animals than MCAO infarct animals at day 3. While the data suggests fewer microglia express $K_{Ca}3.1$ channels following acute DFP intoxication compared to MCAO ischemic stroke, follow-up studies are required to confirm antibody specificity and cell-type expression of $K_{Ca}3.1$.

Morphological Changes in the Ileum Due to Excess Ferrous Sulfate or Ferrous Bisglycinate Chelate Supplementation in Suckling Rat Pups

Richard Dean
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Iron is an essential mineral for human health and is especially crucial for growth and development in infants. However, excess iron induces oxidative stress and damage to cells, and ferrous sulfate supplements can cause gastrointestinal distress. Infant formulas in the US contain, on average, 40x more iron than breast milk even though infant anemia rates are as low as 3%. Recently, iron from ferrous bisglycinate chelate was shown to have higher bioavailability than from ferrous sulfate. In this study, we assessed the effects of excess iron supplementation in the forms of ferrous sulfate (FS) or ferrous bisglycinate chelate (FC) on ileum morphology of suckling rats. Newborn Sprague Dawley litters were randomized into groups receiving 10 mg Fe/kg body weight as FC or FS, or 10% sucrose vehicle control (CON) daily from postnatal day (PD) 2 until weaning. Body weight in the FC and FS groups was significantly increased over CON at PD 10. Ileum iron content in both test groups was significantly elevated. There was no significant difference in villous height or crypt depth among groups. The effect of iron on antioxidant status of cells and subsequent cell damage or death in the small intestine is still under investigation.

Mechanistic Characterization of Tomato DDB1-DDA1 Ubiquitin LigaseComplex

Samuel Deck
Sponsor: Nitzan Shabek, Ph.D.
Plant Biology

Cellular levels of proteins are determined by rates of synthesis and degradation. The central events in the protein degradation process is the recognition and the attachment of ubiquitin molecule to the target protein by a family of enzymes called Ubiquitin Ligases. A group of Ubiquitin Ligases contains the protein DDB1 that serves as a module to recruit targeted proteins for destruction. Interestingly, DDA1 has been shown to be a core component of DDB1 protein complex and its mutant has been implicated in multiple diseases. Yet the exact function of human DDA1 in the DDB1 complex remains unexplored. Plant DDB1 mutants are characterized by exaggerated light responsiveness. Here, we provide a structural analysis of DDB1-DDA1 and demonstrate that tomato DDB1 mutant displays a mutation at the same interface human DDA1 binds. This raises the hypothesis that like the human complex, plants DDB1-DDA1 may share a similar structural interface with yet unknown function. Here we use molecular and biochemical tools to produce tomato DDA1 and DDB1 proteins to decode the role of DDA1 in Ubiquitin Ligase activity of DDB1 complex. This work will establish the foundation of DDB1-DDA1 structural interrogation and will potentially uncover the function of DDA1 in human DDB1 complex.

Antibodies Mediated Depletion of Specific T Cells Population in Animal Model of Primary Biliary Cholangitis

Jorge Del Pozo
Sponsor: Patrick Leung, Ph.D.
MED: Int Med Allergy

Primary Biliary Cholangitis (PBC) is a chronic autoimmune liver disease characterized by the presence of Antimitochondrial Antibodies (AMA) and immune-mediated destruction of small bile ducts. CD8+ KLRG1+ T cells are highly elevated in PBC patients, suggesting their potential as a critical immunological checkpoint. This study aims to examine the potential efficacy of anti-KLRG monoclonal antibodies in depleting KLRG1 expressing lymphocytes and modulating the severity of PBC. Wild-type C57BL/6J mice were chemically induced to develop PBC at 8 weeks of age. At 12 weeks of age, these mice were intraperitoneally administered with anti-KLRG1 antibodies (0.2mg/mouse, 3 times/week). Blood samples were collected bimonthly and mice were sacrificed at 18 weeks of age. Liver and spleen were collected for CD4 and CD8 T cells analysis; liver pathology, AMA and cytokine levels were also examined. Age and sex-matched mice with an isotype antibody control were studied in parallel. Data from a nested of animals have shown a slight decrease in AMA levels in a-KLRG1 treated mice compared to control. Cytokines' immunological changes and liver pathology analysis are in progress.

Structure-Function Analysis of ERMES Lipid-Binding Subunits

Martha Delaney
Sponsor: Jodi Nunnari, Ph.D.
Molecular & Cellular Bio

Membrane contact sites between mitochondria and the endoplasmic reticulum (ER) have emerged as central players in mitochondrial function. The ER-Mitochondrial Encounter Structure (ERMES) is a prototypic membrane contact site in S. cerevisiae. The complex comprises four subunits, three of which (Mmm1, Mdm12, and Mdm34) contain SMP lipid transport domains, indicating that ERMES may play a direct role in ER-mitochondrial lipid transport in vivo. ERMES has also been implicated in both ER-associated mitochondrial division (ERMD) and mitochondrial DNA (mtDNA) distribution, but the mechanism is not known. We hypothesize that ERMES acts to facilitate the creation of lipid microdomains and/or mitochondrial constriction sites that serve as platforms for ERMD and mtDNA replication. I am testing this model using a structure-function approach, mutating highly conserved residues in the SMP domains. These mutants will be analyzed using live cell microscopy to assess ERMES assembly, and mitochondrial and ER morphology. Overall, this work will advance our understanding of the molecular function of ERMES in yeast, which in turn will inform our thinking of ERMD in mammalian cells.

Plastic Free Oceans: Addressing Single Use Plastic Consumption in Davis Restaurants

Sabrina Denton
Sponsor: Andrea Schreier, Ph.D.
Animal Science

The presence of plastic waste in the oceans poses a major threat to marine ecosystems. Numerous marine organisms become entangled in or unintentionally ingest plastic debris. Much of the population is unaware of the consequences of single-use plastics. This project aims to investigate single use plastic consumption in local restaurants in Downtown Davis. We surveyed local restaurants about the single-use products they offer to their customers. We distinguished which restaurants use eco-friendly products, determined how they heard about them, and evaluated the effects they have had on their business. We intend to examine the correlations between education programs, both of employees and customers, with the desire for an adoption of eco-friendly alternatives. We will quantify these impacts by investigating how much plastic can be diverted by making small changes at a local level. We aim to build a local model of community driven change that can be applied to other cities to address this global problem at a larger scale.

The Completeness of Nutrition Disclosures on Online Grocery Store Websites

Laurel Denyer
Sponsor: Jennifer Falbe, Ph.D.
Human Ecology

Online grocery shopping has become a popular way to buy groceries. At brick-and-mortar retailers, nutrition information in the form of Nutrition Facts labels (NFLs) and ingredient lists is readily available on food packages, as mandated by the Nutrition Labeling and Education Act (NLEA). However, for online grocery shopping, regulations have not been implemented, resulting in voluntary and potentially incomplete disclosure of nutrition information online. We aimed to gain insight into the nutrition information available online by coding 34 products often found in Americans' kitchens across 15 leading online retailers. We found that 75% of all products had NFLs and ingredient lists, and 7 of the 15 stores used their own in-house labeling systems to highlight products that meet specified nutrition, special diet, or sustainability criteria. These 7 stores with in-house labeling systems provided NFLs and ingredient lists for 81% of the products, a higher proportion than retailers overall. However, when using NLEA micronutrient and macronutrient requirements, only 14% of products conformed at stores with in-house labeling compared to 31% of products at stores without in-house labeling. Further investigation into the quality of nutrition information on e-grocery websites and its impact on purchasing is needed to inform public health policy.

Myelin Figures Under Stress: Complex Morphologies and Dynamic Instabilities

Prianka Deshmukh
Sponsor: Atul Parikh, Ph.D.
Biomedical Engineering

Lipids are amphiphilic biomolecules with many complex morphologies in nature. In water, they readily self-organize to form a variety of structures including micelles, vesicles, bilayers, and other liquid-crystals. This self-assembling tendency of lipids is the basis of cellular membranes which encapsulate all cells and organelles in living systems. Here at Parikh Lab, I studied rapid hydration of such dry lipid mass, which produces novel concentric multi-cylindrical tubules called myelin figures. By subjecting myelin figures to a variety of environments we can study their dynamic responses while exploring the mechanisms of their growth. We have observed that subjecting a population of tubular myelin to stresses imposed by macromolecules brings single myelin figures into closer proximity and induces wrinkled myelin edges. We propose that this zipper-like motif is due to an effect called the excluded volume interaction, which is unique to large macromolecules, creating this labyrinth-like network of synchronized instability. This observation is biologically significant as it demonstrates the formation of a complex patterned morphology by purely physical forces. Myelin figures can further be compared with innumerable tubular structures in human bodies. Studying their reaction to various stresses can help us understand the mechanisms of how our body reacts to similar conditions.

Arm Posture and Displaced Visual Feedback Independently Influence Arm Reaching Performance

Neena Deshpande
Sponsor: Wilsaan Joiner, Ph.D.
MED: Neurology

It has been previously shown that displacing visual feedback in an unconstrained reaching task can be modeled by a change in hand start location. However, recent results suggest this may not hold for constrained conditions. We examined the influence of arm posture and the dissociation of visual feedback on unconstrained reaching trajectories and constrained reaching force profiles. We trained right-handed subjects to make point-to-point reaching movements with the right arm using a robotic manipulandum. Subjects moved in six workspaces, distributed by 9 cm increments around the midline. Error clamp force profiles were probed in all workspaces, with and without visual feedback dissociation (displacing the cursor 9 cm laterally from the hand). We found that forces during baseline performance significantly changed with arm posture and the addition of a visual dissociation. These two conditions showed differing effects on the kinematic dependence of these force profiles. A gain space model with significant position, velocity, and acceleration dependent components accurately modeled these baseline force profiles. These results show that proprioceptive (via the arm posture) and visual information (via the visual dissociation) affect the force patterns produced during the reaching task and suggest these influences are largely independent in their effects.

Alterity and Augmented Bodies: Representation of Disability in Science Fiction

Ariana Dey-O'Keefe
Sponsor: Michael Ziser, Ph.D.
English

Disability theory defines disability not as a physical impairment, but as emergent from imposed social attitudes and infrastructures that limit what particular human bodies can and cannot easily do. While the social model is a useful framework to examine certain limitations, it often glosses over the complexities of living with an impairment. Science fiction is unique in its ability to complicate questions of reality that imagine how people might live and function in alternate versions of society. Thus, trends in science fiction featuring representation of disabled bodies echoes the evolution of disability discourse as a reflection of social attitudes pushing for augmentation or removal of an impaired body to enforce "normalcy" over inclusivity. Through a new historicism approach, my selected texts will be sectioned to examine a specific thematic facet of disability representation that exemplifies or resists common thought on disability respective to its publication time period. My thesis will investigate how disabled figures may use tech to either reclaim autonomy or contest bodily norms altogether, and critique the immense role society plays in constructing--physically or otherwise--the environment that may or may not be disabling to other bodied/abled people that may necessitate, or coerce, such augmentation.

Maturational Trends in Sleep Spindle Properties: A Longitudinal Study

Pari Dhayagude
Sponsor: Ian glenn Campbell, Ph.D.
MED: Psychiatry & Behav Sci

Sleep spindles are bursts of high-frequency activity (11-15 Hz) which occur during stage 2 of non rapid eye movement sleep and measured using sleep electroencephalography (EEG). Our longitudinal study examined maturational changes in sleep spindle properties (amplitude, duration, density, frequency) over childhood and adolescence. We studied 92 subjects in three cohorts starting at ages 6, 9, and 12 years and ending at 10, 16, and 18 years, respectively. Each subject's sleep EEG was recorded multiple nights every 6 months. A spindle detection algorithm in MATLAB identified spindles and their properties from central electrode recordings. Our findings ($p < 0.0001$ for all) indicate that amplitude decreased by 1.9 μV from an intercept of 61.5 μV at age 6, and duration decreased by 12 ms per year from an intercept of 930 ms. However, density increased by 0.07 spindles/min from an intercept of 4.09 spindles/min, and frequency increased by 0.12 Hz per year from an intercept of 11.07 Hz. Our initial findings confirm conclusions from a previous cross-sectional study examining sleep spindle maturation. A longitudinal approach will allow us to fit more complex models to our data and investigate sex differences in maturational trends once we process the dataset in its entirety.

Differentiating Between Glycoprotein Isoforms Utilizing Ion-Mobility: A Computational Approach

Paris Dhillon
Sponsor: Lee-ping Wang, Ph.D.
Chemistry

Glycans are carbohydrate polysaccharide attachments to proteins that play important roles in signaling and protein folding in vivo. Different isoforms of the same glycan may result in a large difference in the overall protein fold. It is important to be able to separate different glycoproteins from a heterogeneous mixture in order to study the effect of unique isoforms on biological systems independently. Previous experimental work has been conducted to test whether an analytical method that separates samples based on cross-sectional area, known as ion mobility experiments, can separate different isoforms of the same glycan. This project takes a computational approach to interpret the experimental data via simulating the glycoprotein system and calculating the cross-sectional area. The four isoforms of the EEQYNSTYR glycoprotein segment utilized in this study are simulated to obtain representative samples of the molecular structure. The cross-sectional areas are then calculated and converted to ion mobility drift times. The results are analyzed to determine statistical significance of differences in drift times between the different isomers. This study aims to determine whether different glycan isoforms cause a measurable difference in protein fold, which would allow analytical chemists to utilize ion mobility to separate amalgams of different isoforms.

The Effect of Noise Modulation on Recognition Memory and Speech Intelligibility

Journie Dickerson
Sponsor: Lee Miller, Ph.D.
Neuro Physio & Behavior

The manipulation of speech can be used to study the relationship between degraded Mandarin, speech intelligibility, and recognition memory. In this experiment, participants are presented with auditory Mandarin pseudowords. The control condition was unmanipulated and presented at 22,050 Hz. The experimental condition has been manipulated with the addition of frequency-modulated chirps at regular intervals of 24 ms to align with the onset of the speech stimulus, called Cheech (CHirp spEECH, "Cheech"). All participants will initially be presented with 64 counterbalanced pairs of Mandarin pseudowords and images. During the test phase, participants are presented with a combination of old and new pseudoword-image pairs and are asked to determine the membership of each test pair. While Cheech degrades the intelligibility of the presented pseudowords, we hypothesize that the addition of the chirps will also improve recognition memory capacity. Using D' analysis, we compare the proportion of hits and false alarms made by each participant. Participants who recognize pairs more accurately will have a higher D' score, indicating greater recognition. We hypothesize that participants in the Cheech group are expected to have a higher D' score than participants in the control group, indicating a greater recognition of Cheech pseudowords than non-manipulated pseudowords.

Effects of Increasing Iron Doses on Systemic Iron Regulation

Eileen Dihardja
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Infants who are not breast-fed receive iron through enriched formulas or supplements. However, there is concern about adverse effects (decreased growth, increased infections) in infants already having adequate iron status. Therefore, we decided to investigate growth following increasing daily iron supplementation doses in suckling rats. We supplemented treatment litters (10mg, 30mg, or 90mg ferrous sulfate/kg body weight) or vehicle control (10% sucrose) daily beginning postnatal day (PD) 2 until PD10. On PD10, growth was significantly lower in the Fe-90 group compared to control ($p<0.02$). We then investigated iron regulation and growth by measuring the proteins duodenal ferroportin, which transports iron from the duodenum to the systemic circulation, and hepcidin, which disintegrates ferroportin. As we analyzed hepcidin expression using RNA extraction and duodenal ferritin heavy chain protein using Western blots, we found that both were significantly higher in the treatment groups [($p<0.0001$) and ($p=0.0005$), respectively]. However, there was no significant difference in duodenal ferroportin protein ($p=0.4519$). While studies on adult iron regulation have shown that liver hepcidin increases with elevated iron stores and inflammation, these results indicate that excess iron may have negative consequences on infant development, and suggests that iron regulation in newborns/early life is not fully understood.

Techniques for Inexpensive and Accessible Microfluidic Chip Manufacturing

Christopher Dinh
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

RNA-sequencing allows for single celled transcriptional profiling. In an effort to make RNA-sequencing more accessible at a low cost, our team built a quick, reliable, and affordable microfluidics droplet controller. The device utilizes chips with engraved channels to direct droplet flow. Droplet microfluidics relies on high resolution channels to produce droplets capable of encapsulating individual cells. To improve the ability of the chips to consistently create droplets, 3-D printing and low-cost photolithography methods were assessed for their ability to create high resolution channels. To validate both the performance of the device and the capability of each fabrication technique, molds for an encapsulation chip were manufactured at various scales, which were then used to create droplets. Chip production methods were assessed on the following criteria: ease of production, manufacturing time, and ability to produce uniform droplets. Our team aims to produce protocols for both methods of microfluidic chip making. Since both methods are less expensive than the traditional chip making procedure, these protocols should provide value to any lab aiming to inexpensively employ microfluidics. When finished, our team hopes that our work will provide greater access to microfluidics and single-celled transcriptomics for researchers both on and off campus.

Executive Function and Bilingualism: A Study with Young Dual Language Learners in Head Start

Sheyla Dirzo
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Previous studies on children ages 8-11 years old revealed mixed findings on the associations between executive function (EF) and bilingualism. Few studies have been conducted with younger children and with DLLs from different language backgrounds. This study examines the association between EF and bilingualism in 52 Mexican-American and 95 Chinese-American preschoolers enrolled in Head Start centers in Northern California. EF was measured with the Flanker task on the NIH Toolkit and the Head-Toes-Knees-Shoulders test. Children's bilingual proficiency was measured with the Picture Vocabulary, Oral Comprehension, and Understanding Direction subtests of the Woodcock-Johnson Test. Results show no significant difference between the two groups on bilingual proficiency and on the EF tasks. Cluster analysis with home language and English vocabulary resulted in four groups: children with high proficiency in both languages (HI-HI); children with low proficiency in both (LO-LO), English dominant (ENG) and home-language dominant (HL). Examination of the clusters on EF shows that LO-LO scored significantly higher than ENG on the Flanker task and that HI-HI scored significantly higher than ENG on the Head-Toes-Knees-Shoulders task. Results suggest associations between EF and bilingualism may vary by measure and the type of EF.

The Role of the Intras-S Phase Checkpoint in the Induction of Nucleophagy After Replication Stress

Jonathan Do
Sponsor: Kenneth Kaplan, Ph.D.
Molecular & Cellular Bio

One hallmark of genome instability in cancer cells are the appearance of micronuclei. Micronuclei arise from replication stress that slows the resolution of topologically linked sister chromatids in anaphase. In some cases, these linked sister chromatids give rise to micronuclei. Micronuclei can be unstable, and their disassembly can lead to the integration of chromosome fragments into the genome, a process known as chromothripsis, as well as triggering an innate immune response that can lead cellular dysfunction. It is unclear if there are cellular pathways that surveil the presence of micronuclei in order to suppress their formation. In some cells, markers of autophagy have been observed associated with micronuclei and in budding yeast nucleophagy is triggered in the presence of topologically linked sister chromatids that targets nucleolar cargo to the vacuole. The signals that trigger nucleophagy under these conditions remain unclear. We hypothesize that replication stress triggers nucleophagy by an intra S phase checkpoint dependent pathway. To test this, we will measure the targeting of nucleolar cargo to the vacuole after replication stress induced by depletion of either nucleotides or the DNA Poll enzyme and its dependence on checkpoint kinase activity.

Neuronal *Nod-1* Effects on Cognition and Behavior in Transgenic Mice

Angela Dobson
Sponsor: Melanie Gareau, Ph.D.
VM: Anat Physio & Cell Biology

The microbiota-gut-brain axis is a bidirectional signaling network facilitating communication between the enteric and central nervous systems and is known to help maintain homeostasis. Decades of research has elucidated a role for microbiota acting via this axis in the development of pathologies ranging from metabolic disorders to neurodegeneration. Communication along the axis is driven in part by bacteria from the resident intestinal environment producing factors recognized by various immune cell populations or through pattern recognition receptors (PRRs) within resident cells in both the CNS and periphery. Nucleotide-binding oligomerization domain-like (Nod) receptors are intracellular PRRs that sense bacterial products and can induce antimicrobial responses to invasive microorganisms. Nod1 senses the muropeptide G-d-glutamyl-meso-diaminopimelic acid (iE-DAP) derived from peptidoglycan, and when bound to its ligand, activates NfκB signaling resulting in pro-inflammatory cytokine production. Nod1 is also expressed in the brain, but its role in this tissue is poorly understood. To investigate a potentially novel role in cognition, we generated transgenic mice with CamK2a-positive neuronal knockouts of Nod1. Because these neurons are found within the forebrain, particularly in the hippocampus, we hypothesize that Nod1 will affect spatial memory, anxiety, and object recognition. Using a battery of behavioral tests, we will test this hypothesis.

IL-20Rß Expression in the Central Nervous System Contributes to Experimental Autoimmune Encephalomyelitis, a Mouse Model of Multiple Sclerosis

Bryce Dorflinger
Sponsor: Lillian Cruz-Orengo, Ph.D.
VM: Anat Physio & Cell Biology

Multiple sclerosis (MS) is an autoimmune disorder of the central nervous system (CNS). During MS relapses, autoreactive lymphocytes cause demyelination in the CNS white matter, resulting in neurologic deficits such as fatigue, blurred vision, and locomotive and cognitive impairments, among others. There are about 1 million people in the US who have been diagnosed with MS. Immune cell extravasation into CNS parenchyma is a hallmark feature of MS, and is associated with an increase in blood-brain barrier (BBB) permeability. The focus of our investigation is the elucidation of the link between these two processes through analysis of BBB cytokine signaling. The IL-20Rß cytokine receptor has been implicated in other autoimmune disorders such as psoriasis, rheumatoid arthritis, and inflammatory bowel disease, but not in MS or its mouse model experimental autoimmune encephalomyelitis (EAE). Here we show that IL-20Rß knock-out mice demonstrate lessened EAE disease severity than wild-type mice, as assessed through a standard neurological scoring scale. Quantitative analysis of H&E stained spinal cord sections shows a decreased number of perivascular infiltrates among IL-20Rß knock-out mice. Analysis of fluoromyelin staining shows enhanced demyelination among wild-type mice. These results support the hypothesis that signaling through IL-20Rß is an important component of MS.

Museum Design to Preserve Local Culture: Gurase Bhume Aama Samuha Sangrahalaya

Molly Doyle
Sponsor: Nancy Erbstein, Ph.D.
Education

In our presentation, we will discuss our research conducted in the village of Maccahpuchhre, Nepal with the Ghurase Bhume Aama Samuha. We were tasked with creating a mural for a local museum to depict the local Gurung culture of the village and enhance the aesthetics of the museum through the general organization of the space. The village's mothers' group, Gurase Bhume Aama Samuha, has a donation-funded building set aside for the museum. The museum is a tool for the Mother's group to preserve their local traditions as educational and rural modernization creates a disconnect from youth in the village to their local traditions. We planned to achieve our objectives by conducting interviews with museum professionals, researching social and cultural contexts of Nepal that will influence the museum, conducting interviews of members of the Machhapuchhre Village, and working with and for the Aama Samuha. We shared our work with the community by collaborating throughout the ten day process. We asked the Aamas to share their traditions and stories through their artifacts which we then depicted in the three murals and the accompanying shelves.

Exosomes Derived from Human Chorionic Villus Mesenchymal Stromal/Stem Cells Promote Vascularization and Angiogenesis

Shixian Du
Sponsor: Aijun Wang, Ph.D.
MED: Surgery

Tissue engineering has progressed rapidly while effective vascularization of regenerated tissue and organ remains as one of the great challenges. Many studies have reported that human mesenchymal stomal/stem cell (MSC) derived exosomes (MSC exosomes) play a vital role in vascularization and angiogenesis. Exosomes are important intercellular communication tools that deliver bioactive molecules such as growth factors and miRNAs to recipient cells. In particular, MSC exosomes derived from perinatal tissues possess unique advantages over exosomes derived from other adult tissue MSCs for regenerative medicine applications. Therefore, the research goal is to evaluate the proangiogenic capacity of exosomes derived from human chorionic villus MSCs (CV-MSCs). In this study, we isolated the exosomes from CV-MSCs; we confirmed the presence of exosome markers through western blot analysis. In addition, we evaluated the functions of CV-MSC exosomes and confirmed that they significantly improved endothelial cell (EC) migration and tube formation. Consequently, CV-MSC exosomes can enhance EC functions and hold promise to promote vascularization and angiogenesis.

Development of Low-Cost Photodiode Sun Sensors for CubeSat Attitude Determination

Raul Duarte
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

Sun sensors are commonly used to orient spacecraft by determining the relative position of the sun. Commercial sun sensors typically cost several thousand dollars, rendering them an implausible option for undergraduate research applications. This presentation discusses the development of sun sensors that use photodiodes as an inexpensive alternative. Preliminary results strongly indicate the viability of using photodiodes as sun sensors for attitude determination in space. A testbed is developed to facilitate testing of the photodiodes in various configurations and characterize their performance and accuracy. The development of low-cost photodiode sun sensors is documented in more detail than existing literature, describing the implementation of mathematical equations into code, circuitry construction, mechanical and experimental design, and fabrication. The resulting sun sensors design will be used for attitude determination on the REALOP CubeSat, the first satellite created by undergraduate students at UC Davis. Additionally, this documentation will be an invaluable resource for undergraduate students across the world who also choose to take a low-cost approach to attitude determination for their own CubeSats.

Identifying Gait Events from a Sacrum-Mounted Inertial Measurement Unit During Overground Running: a Comparison of Methods

Kristine Dunn
Sponsor: David Hawkins, Ph.D.
Neuro Physio & Behavior

Running is a popular physical activity nationwide but has a high incidence of overuse injuries. Factors that contribute to these injuries are difficult to monitor outside lab settings. Inertial measurement units (IMUs), wearable devices containing accelerometers and gyroscopes, may be able to identify key gait events such as initial and final contact between the foot and ground (IC; FC). These events can be used to measure stance duration, stride duration, and number of steps, which may relate to injury. We evaluated the accuracy of two leading IMU-based gait event identification methods ("Lee" and "Benson") and a novel method ("Dunn"). Previous validation efforts have been limited by small sample sizes and discrepancies in time synchronization between IMUs and forceplates. To overcome these limitations, here, eighty participants ran down a track sixty times each while electronically synchronized data were collected from a sacrum-mounted IMU and forceplate. Using each method, we will identify IC and FC time from IMU signals, calculate stance duration, and compare our findings to 'gold-standard' forceplate measures. Results will characterize the accuracy of each method's identification of IC, FC, and stance duration, which will allow researchers to determine which method, if any, is most applicable for monitoring gait.

Prior Category Knowledge Aids New Learning

Mehar Durah
Sponsor: Charan Ranganath, Ph.D.
Center for Neuroscience

To make decisions in the real world, humans must be able to update their behavior based on new information. Prior work suggests that using inferred category knowledge can help update previously learned information based on a single observation. In addition, evidence suggests that delay-dependent processes may help with the formation of category knowledge. However, it is still unclear how inferred category knowledge influences new learning and what role delay-dependent processes serve in solidifying category knowledge. We developed a novel paradigm to test the influence of previously learned reward and category knowledge on new learning after a 24-hour delay. On Day 1 subjects viewed a sequence of three items and were asked to predict whether a sequence would produce a reward. Embedded in the sequences were items that changed the probability of reward and through trial and error subjects learned which sequences led to reward. Subjects returned on Day 2 to perform the same task, but the reward probabilities were altered. Category-learning performance was assessed after learning on both days. We predicted that participants' category learning performance on Day 1 would be related to their re-learning on Day 2. Preliminary analyses support our prediction.

Development of a Hydrogel Bioreactor for Cost-Effective Extraction of BChE from Transgenic Rice Cells

David Duronslet
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The global bioprinting market is expected to reach over 4.1 billion USD in value by 2026. This explosion of the bioprinting industry includes using techniques like encapsulation of cells in alginate-based hydrogels. These hydrogels can be used as bioreactors for both cell growth and simplified protein extraction. Our team uses hydrogels with rice cells that were engineered to produce tetrameric BChE, a complex human serine hydrolase enzyme that provides protection against organophosphorus poisoning. This particular form of BChE has previously only been found in expired human blood plasma and costs over $10,000 to produce per treatment. By combining hydrogel encapsulation technology, a low-cost bioprinter, and transgenic rice cells, our group is working to develop a method of extraction that reduces the cost of producing this protein. To determine if hydrogel encapsulation is an effective way to extract BChE from transgenic rice cells, we ran repeated Ellman assays to quantify the levels of BChE present in solution over time. To determine if this would be a viable long-term solution to reduce extraction costs from the process of purification, we ran TTC cell viability assays to determine how prolonged exposure to gel affects cell growth and viability.

Infinite Harmonies: The Poetry of Wallace Stevens as Ecological Preservation

Teja Dusanapudi
Sponsor: Joe Wenderoth, M.D.,Ph.D.
English

Despite Wallace Stevens visiting Florida for the first time two years before the publication of his first book of poetry, Harmonium, many of his poems figure its wildlife and wilderness. The disproportionate role of Florida suggests that its ecology left a lasting impact on Stevens, who used the setting as the denominator between his poetic "sense" of the world and his audience's impressions of reality. Stevens' use of the corporeal world as a natural fulcrum between reader and poet is reflected by the constructions the Floridian poems require of the reader: in explicitly emphasizing natural sound and settings as contiguous with the corporeal world and not the diegetic, distinctions between textuality and reality blurs even as they sharpen. These reconstructions implicitly stage ecosystem dynamics of species and areas under the protection of the first US national wildlife refuge, created in Florida only 19 years before Stevens' arrival. In the poetic reconstructions of this refuge the audience reconstructs biological interactions occurring in sound and space, reproducing the conserved ecosystem through poetry. We can understand the work of poetry, then, to be supplementary to preservation; that reconciling the incorporeal with the corporeal allows for shared communication of and through endangered ecosystems.

Single Axis Rotation Testing to Determine Camera Performance Thresholds for UC Davis' CubeSat Mission

Rohan Dutta
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

A critical component to the success of UC Davis' REALOP CubeSat mission is the ability to remotely take clear images of the Earth while in orbit. The goal of this study is to design a controlled testing setup which emulates an orbiting CubeSat to help establish a rotational threshold for which pictures taken by the CubeSat's onboard camera are of acceptable quality for the mission's requirements. An air bearing table is used to produce a low friction, freely rotating surface for testing the Raspberry Pi V2 Camera Module. Experimental parameters for the camera include the picture resolution and the lighting environment. Successful demonstration of the air bearing table for free rotation testing not only determines the requirements for the CubeSat's ADCS (Attitude Determination and Control System), but also serves as a basis to quantify the performance of other components such as reaction wheels and sun sensors to satisfy the mission's requirements. Characterization of the camera will also support its use in missions outside REALOP and in other low budget university satellite missions.

MAGNesia: Magnesium Sulfate Infusion for Analgesia in Critically Ill Trauma Patients

Gabrielle Echt
Sponsor: Christine Cocanour, M.D.
MED: Surgery

Previous studies have shown that infusion of magnesium sulfate during perioperative stages of hospital care helps control surgical pain, therefore reducing the need for traditional analgesics. However, for critically injured patients outside of the operating room, opioid use is often the first line solution for moderate to severe pain management, despite the associated negative side effects. This study hypothesizes that intravenous administration of magnesium sulfate to adults in the intensive care unit (ICU) will significantly decrease their use of opioids while providing adequate pain control. Controlling pain while avoiding or decreasing the use of opioids helps prevent the unwanted side effects of opioids, including drug dependence, nausea, constipation, somnolence, and hypercarbia. By measuring the amount of opioids required in patients receiving an infusion of magnesium sulfate versus patients receiving a placebo infusion- along with collecting patient pain scores before, during, and after treatment- we will be able to determine how magnesium plays a role in alternate pain management methods.

The Effects of Nitrogen Deposition and Water Availability on Germination of Exotic and Native Forbs and Grasses in Serpentine Grasslands

Jillian Dyer
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

Anthropogenic nitrogen deposition is increasing and global precipitation patterns are shifting in Northern California. Serpentine soils are harsh, nutrient poor environments known to have high native plant diversity. This study analyzed the germination of ten different common exotic and native grass and forb species found in a serpentine community at McLaughlin Reserve in order to determine how germination of native and exotic grassland plants is affected by nitrogen deposition and drought. Previous studies of the above-ground community at McLaughlin found that nutrient and water addition increased the proportion of exotic species. We predicted that native forbs would have high germination under drought while exotics would have high germination under nitrogen addition. Under combined drought and elevated nitrogen, we predicted that the exotic species would have lower germination because they would be co-limited by both water and nitrogen. This study will help land managers determine the cause of these above-ground changes in the context of climate change with more frequent drought and increased atmospheric nitrogen deposition.

Analytic Model Development of Water Use and Yield in Central Valley Orchards

Erica Edwards
Sponsor: Kenneth Shackel, Ph.D.
Plant Sciences

Orchard industries consume a significant portion of California's water resources, yet despite the reality of periodic drought, the stress response of trees is not widely documented. This study aims to develop a water production model (WPM) by performing descriptive statistical analysis and characterizing yield based on the water-tree-soil interface. Parameters including irrigation, stem water potential (SWP), and soil moisture are used to model the effect of water stress on almond yield in the Central Valley. In a five-year experimental phase prior to the study, RCB design was implemented at three commercial orchards spanning the Valley length. Blocks were subject to deficit, excess or complete irrigation schemes factored by canopy evapotranspiration needs. WPMs are commonly developed for annual crops but appear to be more complex in trees. Preliminary results do not indicate a linear relationship between applied water (irrigation and precipitation) and yield. Before adding predictor variables beyond applied water to our model, experimental results are being examined to ensure the truest possible representation of the data. We expect to develop canopy-centric, multivariate regression models with standardized coefficients of applied water, SWP, and soil moisture which can best predict almond yields and canopy stress under realistic periods of drought.

Assessment of Mortality and Behavioral Effects of Salinas Valley Agricultural Run-Off on *Daphnia magna*

Nicole Egan
Sponsor: Richard Connon, Ph.D.
VM: Anat Physio & Cell Biology

Aquatic organisms living downstream of agricultural areas are often exposed to agricultural runoff that contains a complex mixture of pesticides. Besides mortality, exposure can cause sublethal effects such as alterations in behavior; a sensitive endpoint of ecological relevance. In this study we aimed to characterize both lethal and sublethal effects of agricultural runoff collected at three sites in the Salinas River watershed, California, using a sensitive toxicological model organism; Daphnia magna. To do this, we exposed D. magna neonates (<24h) for 96h to ambient water samples at 100%, 60% and 30% dilutions. Chemical analyses of site water detected varying concentrations of several pesticides of concern, including Imidacloprid and Chlorantraniliprole; contaminants of emerging concern. Toxicity varied between sites, and showed increasing mortality with concentrations and zero percent mortality in controls. Significant differences in swimming behavior were determined between the treated and control groups. Organisms exposed to non-lethal concentrations of ambient water had significant changes in behavior. This study emphasizes the need to consider sublethal responses when assessing water quality.

Development of Low-Cost Photodiode Sun Sensors for CubeSat Attitude Determination

Shazib Elahi
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

Sun sensors are commonly used to orient spacecraft by determining the relative position of the sun. Commercial sun sensors typically cost several thousand dollars, rendering them an implausible option for undergraduate research applications. This presentation discusses the development of sun sensors that use photodiodes as an inexpensive alternative. Preliminary results strongly indicate the viability of using photodiodes as sun sensors for attitude determination in space. A testbed is developed to facilitate testing of the photodiodes in various configurations and characterize their performance and accuracy. The development of low-cost photodiode sun sensors is documented in more detail than existing literature, describing the implementation of mathematical equations into code, circuitry construction, mechanical and experimental design, and fabrication. The resulting sun sensors design will be used for attitude determination on the REALOP CubeSat, the first satellite created by undergraduate students at UC Davis. Additionally, this documentation will be an invaluable resource for undergraduate students across the world who also choose to take a low-cost approach to attitude determination for their own CubeSats.

Neuromorphic Audio Separation Network

Luis El Srouji
Sponsor: Shirley Chiang, Ph.D.
Physics

Though hearing impairments can be mitigated by amplification devices, modern hearing aids and cochlear implants fall short of full hearing restoration to the wearer in crowded or noisy environments. Modern systems can implement audio-separation or beamforming to identify individual sound sources within a mixed signal, but these are limited by tradeoffs between latency and accuracy. Leveraging the optimization techniques developed in machine learning research, a well-trained spiking neural network could potentially accomplish audio-separation in real-time and with lower power consumption than a traditional computer based on the Von Neumann architecture. A proper dataset would model a range of acoustic environments populated with various sound sources and retain information for the original sound sources it contains. Using acoustic ray-tracing techniques, I develop a model for the sound signals received by a linear, 8-channel microphone array to synthesize a large dataset for the implementation of an audio-separation network on Intel's spiking-neural-network research chip, Loihi.

***In Situ* Synthesis and Coupling of Octadienyl Ether Cellulose Nanofibrils With Polymer Matrices**

Uriel Matthew Enriquez
Sponsor: You-lo Hsieh, Ph.D.
Biological & Ag Engineering

Cellulose nanofibrils (CNFs) are nano-sized fibrils isolated from native cellulose and are high in tensile strength due to their crystalline nature. The surface hydroxyl groups give CNFs their hydrophilic character, which lowers affinity or ability to reinforce hydrophobic polymers. In this study, cellulose was extracted from rice straw, an agricultural waste, through a process of dewaxing, delignification, and hemicellulose removal, then telomerized by reacting with 1,3-butadiene, produced by a dual solvent-reagent to add an octadiene substituent. This leads to an increase in hydrophobicity in the cellulose to potentially improve affinity with hydrophobic polymers and to allow more effective processing in hydrophobic organic solvent. This octadienyl ether (ODE)-cellulose was defibrillated into ODE-cellulose nanofibrils by sonication along with these polymers, namely cellulose acetate, polyacrylonitrile, and polyethylene-block-poly(ethylene glycol). This method merges defibrillation and coupling of cellulose nanofibrils with polymer matrices into one step to increase efficiency. The resulting mixtures were used to produce films, whose strengths were measured.

Determinants of Support for Increased Gasoline Taxation: Evidence from Three Statewide Ballot Measures

Lucas Epstein
Sponsor: Giovanni Peri, Ph.D.
Economics

According to well-respected literature (Parry and Small, 2004), the optimal Gasoline Tax is equal to the marginal external cost of gasoline consumption. However, gasoline tax in the U.S. is far below the marginal external cost of gasoline consumption demonstrating a need for increased gasoline taxes nationwide. My project focuses on three statewide ballot measures to increase gasoline taxes in California, Missouri, and Utah. I perform multiple ordinary least squared regressions within and across the three states to identify economic, electoral, and demographic factors associated with electoral support for increased gasoline taxation. I find that hybrid/electric vehicle ownership is the strongest determinant of electoral support for increased gasoline taxation followed by political party affiliation. Interestingly, I also find the change in gasoline tax support associated with changes in population density and gas price to be insignificant after controlling for other factors. Additionally, I project support for gasoline taxation in each state and find that most states are not predicted to support increasing gasoline taxes.

Maturational Trends in Sleep Spindle Properties: A Longitudinal Study

Harrison Espino
Sponsor: Ian glenn Campbell, Ph.D.
MED: Psychiatry & Behav Sci

Sleep spindles are bursts of high-frequency activity (11-15 Hz) which occur during stage 2 of non rapid eye movement sleep and measured using sleep electroencephalography (EEG). Our longitudinal study examined maturational changes in sleep spindle properties (amplitude, duration, density, frequency) over childhood and adolescence. We studied 92 subjects in three cohorts starting at ages 6, 9, and 12 years and ending at 10, 16, and 18 years, respectively. Each subject's sleep EEG was recorded multiple nights every 6 months. A spindle detection algorithm in MATLAB identified spindles and their properties from central electrode recordings. Our findings ($p < 0.0001$ for all) indicate that amplitude decreased by 1.9 μV from an intercept of 61.5 μV at age 6, and duration decreased by 12 ms per year from an intercept of 930 ms. However, density increased by 0.07 spindles/min from an intercept of 4.09 spindles/min, and frequency increased by 0.12 Hz per year from an intercept of 11.07 Hz. Our initial findings confirm conclusions from a previous cross-sectional study examining sleep spindle maturation. A longitudinal approach will allow us to fit more complex models to our data and investigate sex differences in maturational trends once we process the dataset in its entirety.

Development of Flight Software and Analysis Tools for CubeSat Attitude Determination and Control System

Natasha Evans
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS software development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Flight software is developed to determine and control the attitude or orientation of the CubeSat by integrating sensor data and giving commands to the hardware. The attitude determination algorithm, TRIAD, is developed to integrate sensor data with mathematical models to output the state of the satellite. The output is used by B-Dot and PD, which are closed-loop algorithms allowing the hardware to stabilize the satellite and point the cameras towards Earth. Integrated software and hardware testing is performed to verify that the system meets requirements. A virtual model of the CubeSat, VirtualSat, is also in development to simulate the in-orbit motion of the satellite, while taking external factors like drag, solar radiation, etc. into account. VirtualSat will be an open-source tool that will allow other missions to visualize spacecraft dynamics and develop control algorithms.

Compositional Analysis of Human Milk Oligosaccharides via Liquid Chromatography-Mass Spectrometry (LCMS)

Yuting Fan
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

Human milk is mainly comprised of proteins, fats, and carbohydrates, with oligosaccharides being the third most abundant component. Unlike other macronutrients, human milk oligosaccharides (HMOs) are indigestible for newborns; however, HMOs play a crucial role in developing healthy intestinal microbiota, inhibiting pathogenic infections and supporting infant brain development during the early stage of life. The HMO composition is individualized and varies between mothers. The differences in HMO compositions can be influenced by the mothers' secretor status and the decoration factors on the sugar structures which can result in functional variations. In this study, human milk was collected from 90 healthy lactating women and analyzed for HMO compositions using liquid chromatography coupled with mass spectrometry. Over a hundred HMOs were structurally elucidated along with the secretor status of each mother. Secretor status is based on their genetic expression of the FUT2 gene, enabling the formation of ?1,2-fucosylated compounds. Mothers with secretor marker (2'FL, LDFT, DFLNHa, TFLNH) percentages higher than 6% were determined to be secretors. The total amount of fucosylated and undecorated oligosaccharides in the mothers' milk were found to be statistically higher in secretors, while the total amount of sialylation structures appeared to be higher in non-secretors.

Cloning and Expression of Antibacterial Mammalian Milk Peptides in Yeast

Zixuan Fang
Sponsor: David Mills, Ph.D.
Viticulture & Enology

Mammalian milk, a complete food for the newborn, is nourishing and protective. Detailed examination of milk components reveals novel constituents with a variety of roles. One such group of functional molecules are milk peptides released from specific proteins via proteolysis in the mammary gland. We recently demonstrated some naturally-occurring peptides exhibit antibacterial properties against specific pathogenic bacteria. In order to carry out structure-functional analysis, we used a yeast protein expression for obtaining sufficient quantities of the peptides. Here, we used the Kluyveromyces lactis platform for protein expression to obtain large quantities of the peptides in yeast supernatants. We cloned the peptide-encoding sequences into the Escherchia coli-K. lactis shuttle vector and obtained yeast transformants that were verified to be chromosomal integrants. Currently, we are optimizing conditions for expression and secretion of the peptides, These peptides will be tested for activity in antibacterial assays using select Gram-positive and Gram-negative pathogens.

Implementation of the Health Belief Model on the *Hmong Population*: Online Health Education on Hypertension

Alexander Fang
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

Cultural and religious beliefs within the Hmong community have caused misunderstandings and mistrust regarding allopathic approaches of medicine. Concepts such as chronic illness, susceptibility, and prevention are often unknown or misunderstood resulting in minimal knowledge of prevalent diseases and low participation in accessible preventative services. This study aims to understand whether online, educational videos using the Health Belief Model are an effective method in improving the Hmong populations' health perception. An online survey was distributed via Qualtrics from January 31st-February 8th. To address linguistic barriers, the survey offered English and Hmong surveys, asking various demographic questions along with a pre-survey and an additional post-survey following an educational hypertension video. Using the 3 point Likert scale, data was computed on a standardized 0-50 point scale. Average differences of pre-and-post survey scores were used to identify effectiveness of educational videos. Analyses reveal a significant increase in health perception of hypertension after exposure to the video ($p=.0027$). Limitations of the data collected, shortcomings of current methods as well as channels for improvement are also discussed. Results will assist in providing more insight and implementation of effective health educational methods concerning the Hmong population.

Ukraine's Black Sea Nuclear Security Dilemma

Bryn Farrington
Sponsor: Jaime Jackson, Ph.D.
Political Science

Nuclear security around the Black Sea is paramount to preserving regional peace. Ensuring stability around the Black Sea secures both Europe and the Caucasus regions. Ukraine's role is key to ensuring regional security. The key threat to nuclear security in the decades following 9/11 has evolved from state actors to non-state actors acquiring fissile materials (NSS, 2002). Strategies must evolve to meet new threats. To promote regional nuclear security, I propose a manifold strategy. The first is to regain situational awareness in contested parts within Ukraine. The second is developing stronger communications system between Black Sea nuclear security stakeholders for the sake of sharing pertinent information. Broadly, strategies implemented must directly address the information problem in nuclear security. Within Ukraine, separatist groups may have acquired enough fissile materials to make dirty bombs. During its civil war, Ukraine has lost control over numerous nuclear facilities into the hands of nonstate actors. This threatens not only Ukraine, but also other regional actors. This paper will expand on the above strategies to address these problems and discuss implications throughout the Black Sea region.

Older Versus Younger Adults' Positivity Bias in Episodic Memory

Caitlyn Rose Fastenau
Sponsor: Beth Ober, Ph.D.
Human Ecology

Memory for positive items (e.g., parrot) is generally better than memory for negative items (e.g., snake), known as the positivity bias. A significant increase in positivity bias, in favor of older versus younger adults, is often obtained; this is referred to as an age-related positivity effect. Our current study is an episodic memory list paradigm for two valence categories (positive and negative words), from several semantic categories (e.g., animals, places, events). Results show a significant main effect of valence supporting a positivity bias for both the younger and older adults. Additionally, there is a significant interaction of Age X Time (immediate vs. delayed recall). However, there is a nonsignificant Age X Valence interaction, therefore a nonsignificant age-related positivity effect. This presentation focuses on possible explanations for our primary findings, via the analysis and interpretation of three sets of secondary data as well as insight into learning and retention with age. These data sets include: (1) semantic versus valence clustering during list recall trials in older versus younger adults, (2) correlational relationships between clustering measures and demographic variables, and (3) correlational relationships between clustering measures and positivity bias for older adults.

Models of Workforce Affordable Housing Over Time

Mikaela Fenton
Sponsor: Noli Brazil, Ph.D.
Human Ecology

California is facing a housing crisis—as wages have remained relatively stagnant, housing prices have skyrocketed. One group that has been highly affected has been the workforce, or moderate income citizens, who often have to contribute over 30% of their income towards housing expenses. To answer the question of how best to provide affordable housing to this group, I analyzed six different models of market rate and affordable housing in the city of Davis. This included market rate homes and apartments, Dos Pinos housing cooperative, Aggie Village, Southfield Park, and the Davis affordable housing homebuyers program. I compared the level of affordability for each model from the time the model was first implemented in Davis, to today. I found that while each model of affordable housing was less expensive than the comparable market rate option, certain models were more effective at producing affordable prices as well as increasing affordability over time. These differences should be recognized and the most effective models should be implemented in future plans for creating affordable workforce housing.

Environmental and Performance Testing of Hard Disk Drives as Low-Cost CubeSat Reaction Wheels

Dan Austin Fernandez
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Hard Disk Drive (HDD) tech demonstration of the ADCS for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Commercial CubeSat reaction wheels cost on the order of 10^4 to 10^5 USD. REALOP will repurpose 30 USD hard disk drives, typically found in laptops and iPods, as a low-cost alternative to commercial reaction wheels. Mass-manufacturing of HDDs to high precision standards make them a very reliable and accessible technology. A highly configurable, low cost ESC IC was adapted to control and report the speed of HDD motor for precision attitude control. Appropriate mass and speed properties indicate that HDDs can meet the control requirements of the 2U REALOP CubeSat. Environmental testing is performed on multiple popular and readily-available models of HDDs to verify which can, or cannot, withstand launch and orbit conditions. Performance testing is conducted on an air-bearing testbed to characterize the HDDs and demonstrate that they meet mission pointing and stabilization requirements. Successful integration and on-orbit testing can further prove the utility of HDDs as reaction wheels for low-budget small satellite missions.

The Holographic Survivor: Holocaust Memory, Preservation, and Performance in Memory Institutions

Nastassya Ferns
Sponsor: Diane Wolf, Ph.D.
Sociology

As the number of remaining Holocaust survivors dwindle, direct connections to their lives and stories fade into distant memory. How are memory institutions dealing with the loss of survivors? New interactive digital technologies may hold the key to establishing a connection to the past when a Holocaust survivor is no longer living and able to testify. Stepping away from traditional media formats such as documentaries or photographs, a partnership between the USC Institute for Creative Technologies and the USC Shoah Foundation has resulted in the creation of a remarkable technology: the Holocaust survivor hologram. Entitled New Dimensions in Testimony, the project promises to preserve dialogue between survivor and learner, allowing younger generations to acts as witnesses far into the future. However, with the introduction of this new technological experience, we are forced to reframe and renegotiate our relationship to Holocaust survivors and memory. This analysis addresses the implications of this experience, as well as examining the ways memory institutions facilitate a stimulating, engaging performance when utilizing the hologram.

Influence of Fleece Length in Mature Sheep on Thermal Surface Temperature Measurements

Tessa Ferrari
Sponsor: Lee Pettey, Ph.D.
Animal Science

In the U.S., wool is a $45 Million industry (USDA, 2018) with many breeds of sheep being selected for superior traits. A detection method for total fleece value would be useful for breeding animal selection. The objective of our study is to determine if a thermal imaging camera can accurately detect differences in fleece length before the wool is sheared. Data from an initial pilot study indicates that thermal surface temperature is reduced by approximately 0.25 degrees F for every millimeter in fleece length. In the current study, twenty crossbred ewes will be used to define the relationship between fleece length and thermal surface temperature. Each sheep will have four 5x25 cm strips of wool sheared to one of four lengths: 0, 2, 4, and 6 cm on their left side. Fiber diameter, fleece density and ambient temperature will also be measured. Regression analysis will determine the relationship between wool length and surface temperature. The expected relationship is: as wool length increases, external body temperature decreases. The goal is to develop an equation where external temperature readings, along with fiber diameter and body size, can rapidly determine the approximate weight of fleece to be produced.

Serum Inflammation Markers and Body Mass Index in Children

Elis Feyzieva
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

The cytokine Interleukin-6 (IL-6) is released during immune reactions such as infections, injuries and chronic stress. Although transient production of IL-6 is part of the normal immune response, previous research has shown that chronic increased levels of the inflammation marker IL-6 is linked to increased risk of obesity, diabetes and cardiovascular disease in adulthood. In this study, we aim to see if there is an association between the inflammation marker (IL-6) and Body Mass Index (BMI) in children. These analyses can determine if patterns of high levels of IL-6 are linked to markers of obesity, which could make children more susceptible to health complications in the future. We aim to examine this association of BMI and IL-6 at baseline, upon coming into the laboratory. IL-6 levels for 102 children (age 9-11) were measured using a blood draw and then compared to their calculated BMI using linear regression. Results indicate that there was an association between high levels of IL-6 at baseline and high BMI. This indicates that high levels of IL-6 is associated with high BMI, which may act as a predisposing factor for adult obesity, diabetes, and cardiovascular disease.

Virgin Beta Cells are Distinct From Senescent Beta Cells Within Mouse Pancreatic Islets

Wahed Firoz
Sponsor: Mark Huising, Ph.D.
MED: Physiology & Membrane Biol

Type 1 Diabetes (T1D) is characterized by an autoimmune-mediated destruction of pancreatic beta cells. Thus, significant research aims toward treating T1D by beta cell regeneration. To this end, we discovered a novel subpopulation of immature beta cells, named virgin beta cells, that are localized exclusively near the islet periphery. Virgin beta cells hold the potential to serve as a possible novel source for beta cell regeneration, but remain to be fully characterized. My project seeks to characterize if virgin beta cells are the same as senescent beta cells, another beta cell subpopulation that also lacks expression of key beta cell maturity markers. Given the distinctive peripheral localization of virgin beta cells and the random distribution of senescent beta cells, I hypothesize that virgin and senescent beta cells represent different cell populations. To test my hypothesis, I immunostained pancreatic tissue sections from transgenic Cdkn2a null mice that do not undergo senescence and manually counted islet cells to determine if virgin beta cells persist in these islets. My data demonstrates that virgin beta cells are present in Cdkn2a null mice at a similar fraction and location as wild-type controls, suggesting that virgin and senescent beta cells are distinct subpopulations of beta cells.

Phenotypic Traits of Plantago lanceolata as Related to Density and Demography

Samuel Flohr
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

This project is a continuation of a study on the globally-distributed perennial plant Plantago lanceolata that has been conducted annually since 2016. This study uses the protocol of Plant Pop Net, an international project, which aims to understand the factors driving the spatial dynamics of plant populations in response to climate change using data from P. lanceolata populations around the world. At our site in Davis, CA, we measured the abundance and phenotypic traits of P. lanceolata for four years. The trait data includes floral characteristics, phenology, morphology, and signs of herbivory. Using this data, we want to investigate leaf area as a measurement of plant size as well as compared to rosette density. We would like to explore what affects plant size and density have on survival and reproduction. In previous years, we have found relationships between plant size and density to be significant. We would like to further examine these relationships through comparison with past data from our site.

Investigating the Effects of the Western Diet on Metal Regulation in the Pathogenesis of Liver Disease

Devon Flood
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

Non-alcoholic fatty liver disease (NAFLD), characterized by accumulation of fatty acids in the liver, is currently the most common chronic liver disease in Western nations. NAFLD is correlated with elevated consumption of sugars and non-nutritive sweeteners like aspartame, components that are increasing in the Western diet. Interestingly, patients with NAFLD exhibit deficiencies in iron and copper. It is posited that these deficiencies reduce antioxidant defenses thereby increasing oxidative stress, a key factor in disease progression. To investigate the interplay between the Western diet and metal metabolism in NAFLD pathogenesis, we explore how metal biochemistry is affected in human liver cells (HepG2) stimulated with varying sugar and aspartame concentrations. We monitored metal regulatory proteins at both the gene expression and protein levels using real time PCR and Western blots, respectively. By understanding how the Western diet, particularly sugar and aspartame, affect copper and iron homeostasis in vitro, we hope to elucidate the underlying molecular mechanisms that contribute to NAFLD and provide insight into therapeutic and diagnostic approaches.

Thermal Tolerance and Heat Hardening Ability Between Sexes in *Gambusia affinis*

John Amiel Flores
Sponsor: Anne Todgham, Ph.D.
Animal Science

As consequence of climate change, water temperatures increase at rates that most fish are incapable of accommodating. Mosquitofish (Gambusia affinis), an invasive live-bearing fish commonly used to control mosquito populations, can tolerate extreme conditions including high water temperatures and acute temperature spikes and, hence, can wreak havoc in freshwater ecosystems. Given their capacity to tolerate rapid warming, mosquitofish invasiveness will continue to exacerbate. Several studies conducted stress tolerance tests on mosquitofish to quantify fitness and predict responses to climate change. Few studies examined differences in stress tolerance between sexes, possibly overlooking an underlying factor in the fitness and ecological impact of each sex. This study investigated differences in upper temperature tolerance (UTT) of mosquitofish sexes. I hypothesize females will have higher UTT and expanded capacity to increase thermal tolerance [i.e. heat hardening (HH)] compared to males. To test this, I assessed UTT using the critical thermal maxima methodology (CTMax) on males and females by increasing water temperature at a rate of $0.3°C min^{-1}$ until fish lost equilibrium. Fish were given a 24-h recovery period before another CTMax to evaluate heat hardening. Although non-significant, females had slightly higher capacities to HH. Ecological implications in a warming world will be discussed.

Gender Differences in Behavioral Strategies for Delay of Gratification

Jasmine Flores
Sponsor: Daniel Choe, Ph.D.
Human Ecology

Early success in delaying gratification has been associated with positive developmental outcomes such as socioemotional competence, better mental health, future career success, and greater relationship quality. Studies of children's self-regulation have found that girls typically perform better than boys on delay of gratification tasks, which measure impulse control; however, it remains unclear which behaviors contribute to girls' better task success. A sample of 70 preschool-aged children (M = 50.8 months, SD = 4.77, 48.6% girls) performed a gift delay task in which children were left alone for three minutes and told not to touch a gift placed in front of them. Task success was defined by whether or not they touched the gift. The following behaviors were behaviorally-coded during the task in ten-second increments: focusing on object, behavior distraction, attention distraction, and passively waiting. With preliminary data (n = 28), there is a marginally significant gender difference in task success in the expected direction, but with a larger sample we expect to find a significantly higher success rate in girls, attributing their success to behaviors in which attention is averted from the gift. Children's ability to self-regulate in early childhood provides a basis for greater academic development and social relationships.

Characterizing Lactoferrin and Paneth Cell Proteins as Inflammatory Markers in a Mouse Model of Colitis

Manuel Flores Rodriguez
Sponsor: Charles Bevins, M.D.,Ph.D.
MED: Medical Microbiology & Imm

Inflammatory bowel disease (IBD) is characterized by chronic inflammation of the gastrointestinal tract. Disease is assessed by fecal markers of leukocyte infiltration including neutrophil-derived lactoferrin. Paneth cells (PC) are specialized epithelial cells that secrete antimicrobial effector molecules such as defensins. Previous work in our lab demonstrated expression of PC defensins were decreased in human Crohn's disease. The in vivo response of PC products (e.g. defensin 24, lysozyme, intelectin) during inflammation remain to be elucidated in mice. Herein, we propose to use an established infection model of colitis (Citrobacter rodentium) to explore the potential modulation of PC products during a chronic inflammatory response. Wildtype and lactoferrin knockout mice will be monitored for 21 days post-infection with daily fecal collection. Proteins of interest will be interrogated using biochemical protein analysis. Based on previous human research, we expect fecal lactoferrin concentration to increase upon induction of the inflammatory response, whereas we hypothesize that PC defensins will decrease. Experimental findings in this model will help to characterize the in vivo response of PC effectors during onset, progression and resolution of intestinal inflammation, and serve as a methodological tool to assess disease activity and to understand PC functions.

Study of Rice Husk Ash as an Alternative to Cement

Audrey Florman
Sponsor: Sarah Miller, Ph.D.
Civil & Environmental Engr

Currently cement creates about 8% of global carbon dioxide emissions. This percentage is increasing as concrete is the key building material in most towers, parking garages, dams and most other structures. Thus, research in alternative materials to cement is becoming increasingly important. This research focuses on looking at rice husk ash (RHA) as a replacement for cement with regards to emissions, durability, and mechanical properties. A control mixture was compared to a mixture with 15% cement replacement of RHA by mass. These mixtures were tested for effects from exposure to sulfate solution (C1012/C1012M), electrical resistance to chloride ion penetration (C1202 – 19), and 28 day compressive strength (C39/C39M – 18). The emissions, energy, and global warming potential for each mixture was calculated using Green Concrete LCA Web Tool. RHA had a lower compressive strength and more electrical resistance to chloride ion penetration than that of the control mix. The cement mix was found to have more emissions, energy usage, and global warming potential than the RHA mixture. While the RHA mixture has a lower compressive strength, durability properties, lower emissions, energy usage, and global warming potential make more research into rice husk ash as a cement replacement a worthwhile investment.

Rain Garden Effects on Urban Stormwater Runoff Quality in Major California Cities: A Comparative Literature Review

Abraham Fong
Sponsor: Elizabeth Boults, M.L.A.
Human Ecology

Stormwater runoff quality is an integral part to the California lifestyle; it supplies recreational areas, potable water sources, and biological habitat. As California continues to urbanize and to develop existing rural land, pollutants from machinery, fertilizers, and transportation equipment will increase and are likely to threaten stormwater runoff quality in California. Inorganic and organic pollutants such as nitrogen, nitrite, phosphorus, carbon, and potassium threaten to clog waterways, choke wildlife from algal bloom, and create unmitigated water runoff speeds. Consequently, major metropolitan areas within California such as Los Angeles, San Diego, and Alameda County, have opted to retrofit urban areas with rain gardens to slow down stormwater runoff and to filter out inorganic stormwater pollutants. Therefore, it is imperative in the most populous state in the Union to investigate the effect of rain gardens and bioswales on stormwater pollutant water quality. The purpose of this research project is to explore how rain gardens function and how they affect stormwater runoff quality in major California cities. Research methods include literature review of rain garden performance across the continental United States and examining case studies of California rain gardens in various parts of California.

Effects of Increasing Iron Doses on Systemic Iron Regulation

Bradley Fong
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Infants who are not breast-fed receive iron through enriched formulas or supplements. However, there is concern about adverse effects (decreased growth, increased infections) in infants already having adequate iron status. Therefore, we decided to investigate growth following increasing daily iron supplementation doses in suckling rats. We supplemented treatment litters (10mg, 30mg, or 90mg ferrous sulfate/kg body weight) or vehicle control (10% sucrose) daily beginning postnatal day (PD) 2 until PD10. On PD10, growth was significantly lower in the Fe-90 group compared to control ($p<0.02$). We then investigated iron regulation and growth by measuring the proteins duodenal ferroportin, which transports iron from the duodenum to the systemic circulation, and hepcidin, which disintegrates ferroportin. As we analyzed hepcidin expression using RNA extraction and duodenal ferritin heavy chain protein using Western blots, we found that both were significantly higher in the treatment groups [($p<0.0001$) and ($p=0.0005$), respectively]. However, there was no significant difference in duodenal ferroportin protein ($p=0.4519$). While studies on adult iron regulation have shown that liver hepcidin increases with elevated iron stores and inflammation, these results indicate that excess iron may have negative consequences on infant development, and suggests that iron regulation in newborns/early life is not fully understood.

PT(Street)D: Police Violence

Ryan Fonseca-Vega
Sponsor: Natalia Deeb Sossa, Ph.D.
Chicano Studies

The state of mental health among individuals who have been harassed by police officers is an issue that has not been researched enough. The USA is split between the two movements--Black Lives Matter and Blue Lives Matter— with each arguing for either police officers needing to change their tactics or that they are doing what they are trained for the safety of them and others. More research needs to be done on the trauma of individuals who have been harassed and “policed” by police officers as well as any family and/or members of the community who have witnessed the atrocities committed by them in the name of safety. This research will focus on and publicize the trauma that occurs to communities when police officers “police" using their outdated tactics. I will conduct surveys and interviews of individuals who have been impacted by these actions. The broad results of this research will suggest that individuals have more trauma caused by police officers than is known publicly. Lastly, the research results are being used to advocate for the provision of mental health workshops and healing gourds for the individuals, family members, and communities and to propose legislation to hold police officers accountable.

What Can Post-collisional Plutonic Events Tell Us About the Tectonic History of the Alaska Range Suture Zone?

John Foran
Sponsor: Sarah Roeske, Ph.D.
Earth And Planetary Sciences

The Alaska Range suture zone south of the Denali Fault formed between the Yukon-Tanana terrane and the Wrangellia composite terrane. The variable age distribution of plutons along the suture zone is poorly understood. Moving from west to east south of the Denali Fault there are not well-defined suites of granitoids and the little we know is based on minimal U-Pb zircon ages. Paleozoic and Mesozoic granitoids in Wrangellia, such as those found in the Skolai and Chisana arcs, record subduction zone events. However, there are many granitoids with post 90 Ma ages in the suture zone that are recording igneous processes more than 300 km inboard of the subduction zone and do not clearly relate to subduction processes. The first step in classifying this distribution of plutonic rocks is to petrographically describe them and attempt to group them by age and composition. Preliminary results from new U-Pb zircon ages suggest there are three distinct populations centered around 38, 56, and 70 Ma. Additional U-Pb zircon dates and petrographic descriptions will build on these preliminary findings and provide a basis for more advanced classification of these suture zone granitoids.

Distinguishing the Effect of Microhabitat Variation on the Occupancy of Breeding Birds in Glenn County, California Using Automated Recording Units

Danielle Fradet
Sponsor: John Eadie, Ph.D.
Wildlife & Fisheries Biology

Landscape level avian occupancy modeling has recently been at the forefront of avian biodiversity studies in California's Central Valley. A 2018 study uses automated recorder units (ARU) to gather bird data across the Valley landscape. ARUs can be used to saturate a large landscape with time dependent surveys of birds; thus gathering more data on bird presence than traditional point counts. The results from the Central Valley study provide avian habitat occupancy models based on vegetation cover classes and predicts avian diversity based on habitat heterogeneity. My study will test ARU method at a microsite and compare site-specific results to those predicted from the landscape-level study. To test microsite occupancy of breeding birds, 360, 5-minute recordings were taken in spring and summer of 2019 at Bird Haven Ranch (BHR) in Glenn County. BHR is a heterogeneous habitat of rice, wetlands, and riparian systems. Recordings were balanced so effort was standardized between the three main habitat types. Interpretation of avian recordings will allow me to construct a detection history for use in occupancy estimation on BHR, and compare results to predicted occupancy models for the Sacramento Valley. If found predictive, ARU method might be more broadly applied for site-specific diversity studies.

Helping Infants Learn Language: Do Parents Exaggerate Speech Sounds When Talking to Infants?

Kimberly Francis
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

Caregivers often alter their speech when speaking to infants, using a speaking style known as infant-directed speech (IDS). The current study explores this phenomenon by investigating whether parents hyperarticulate, or exaggerate speech sounds, to make their speech more clear when talking to infants. Specifically, we are investigating how parents vary their production of "t" sounds in speech towards infants versus adults. We are coding emphasized and reduced "t" sounds (e.g. 'cheetah' pronounced with a clear "t" versus a "d" sound; 'cat' produced with a clear versus dropped "t"). Parents engage in two sessions of interactive tasks—first with their infant (11-month-olds and 19-month-olds), then with an experimenter. Parents are asked to incorporate a set of consistent target words to encourage the use of words with "t" sounds across both speaking registers. Sessions are audio and video recorded and analyzed for the "t" articulation as well as the positioning of the target words in sentences. Our preliminary data include 10 participants, but coding is ongoing. We predict that parents try to present helpful language learning tools to their infants. Therefore, they will produce more clear speech to their infants than to adults, showing more hyperarticulation in IDS.

Improving the Time and Cost-Efficiency of the Tobacco Mosaic Virus ELISA

Natalia Franco-Hernandez
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The enzyme-linked immunosorbent assay (ELISA) has been one of the most widely used plant pathogen detection methods since its invention in the early 1970s. The method involves using an antibody to immobilize an antigen and a second enzyme-conjugated antibody to detect the virus colorimetrically. Although popular, because it gives the opportunity for quantitative and accurate diagnosis, the ELISA can be a time-consuming assay, often taking lab technicians two days to get a diagnosis. In that time, a virus can quickly spread, potentially ruining a crop destined for seed stock. The aim of this project is to reduce the time and person-hours needed to perform an ELISA for tobacco mosaic virus (TMV). We are exploring the influence of changes to numerous experimental parameters on the sensitivity, cost, and time associated with the assay. For example, in early experiments, we explored different modes of mixing and sample incubation on the efficiency of the binding between the coating antibodies and the sample. Early results show that incorporating shaking at 125 rpm into the sample incubation step will reduce the amount of time needed to perform an ELISA while maintaining the expected sensitivity of the assay.

The Intersection of Science & Poetry: Poets & Their Use of STEM Allusions

Lauren Frausto
Sponsor: Colin Milburn, Ph.D.
English

There is a long-standing rift between the sciences and humanities. Each is seen as inaccessible by the other and this rift is often marked by a failure of communication. Despite the enduring division, a phenomenon worthy of investigation exists in a small minority of poets who use STEM allusions in that they have committed to intimately engage with the divide for purposes of artistic self-expression and recreation. The embodiment of the combination of science and poetry in the creative lives of such poets begs the question: what are the qualities inherent to this fringe population that allow this science/poetry unification to flourish where elsewhere the sciences and humanities cultures are at odds? In my qualitative study I am interviewing fifteen poets in person, using a combination of structured and unstructured recorded interviews. Recruiting subjects via social media and local events, I am seeking poets from a range of STEM backgrounds and affiliations. I am focusing on "amateur" poets, to be measured by their body of publication, social media following, and/or performance frequency, as I am most interested in the genesis and growth of the science/poetry connection and the implications of that connection at the community level.

Low & High Performing Schools in the Sacramento & San Joaquin County Districts of California

Crystani Freeman
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Human Ecology

Education is highly emphasized across the United States and has set the foundation for success. Education is available across public, private, and homeschooling systems; however, the public education system remains a dominant source. Public education in the United States includes federally funded schools administered to some extent by the government, responsible for educating all citizens, including the accessibility to primary, secondary, and some public institutions of higher education. This paper aims to discover how the social-environmental characteristics of a low and a high performing school in California vary in Sacramento and San Joaquin County school districts. The researchers used secondary data from online articles and statistical databases for this project. The statistical data from these sources were analyzed using PSPP and Microsoft Excel computer programs. For every county examined, the findings reveal that school performance is dependent on a student's background, status, and environment. These conclusions are drawn from an analysis of public data, making this information easily accessible to the public and other concerned parties. As education continues to be an integral factor towards social and financial success, educators, community members, and policy should focus more attention on the hidden factors that contribute to student performance in public schools.

Understanding Social Reward Learning: Sex Differences and Associations with Psychiatric Symptoms

Matilda Fritz
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MED: Psychiatry & Behav Sci

Successful social interactions are inherently rewarding and require intact social reward learning; i.e., the incorporation of social feedback to regulate and motivate social behavior and maintain relationships. Impaired social reward learning may contribute to impaired social functioning, a feature of psychiatric disorders like Major Depressive Disorder (MDD). MDD is characterized by reduced motivation, blunted response to monetary rewards, and impaired social functioning, and affects females more frequently and severely than males. However, social reward learning in MDD remains understudied and sex differences are unknown. This study examines sex differences in social reward learning and how individual differences in social reward learning relate to depression, anxiety, and alexithymia symptoms. Participants will complete the Dynamic Social Learning Task, in which the participant's choice of slot machine results in videos of people saying positive, negative, or neutral statements. Their goal is to see positive or neutral outcomes; a higher percentage of trials with optimal outcomes indicates better social reward learning. We hypothesize: 1) females will demonstrate better social reward learning than males and if females have depression symptoms, that this sex difference will be reduced; 2) Across all participants, reduced social reward learning will be associated with more severe depression, anxiety, and alexithymia.

Identification, Characterization, and Implementation of Effective Biocontrol Agents and Natural Plant Compounds to Protect Pruning Wounds from Grapevine Trunk Disease Pathogens

Timothy Gallagher
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Anr Plant Pathology

Grapevine trunk diseases (GTDs) pose a great threat to the stability of global grape production. Fungal pathogens that induce Esca, Bot canker, and Eutypa dieback are particularly detrimental to vineyards, causing widespread damage and reduced yields. GTD-related pathogens infect primarily through the exposed wood vessels of pruning wounds. Current control methods treat pruning wounds with chemical protectants, which have reduced efficacy over time due to resistance development. A promising alternative is the utilization of naturally occurring microorganisms found on the surface of pruning wounds (epiphytes) and within xylem sap of freshly pruned spurs (endophytes) as biocontrol agents. Our research aims to discover possible microorganisms and plant compounds to be used as biocontrols to protect pruning wounds and manage GTDs. Isolated epiphytes and endophytes were identified using molecular and phylogenetic analysis. In vitro inhibition bioassays measured how effectively biocontrol candidates inhibited and suppressed the growth of two prevalent pathogens: Eutypa lata and Neofusicoccum parvum. Several species within the genera of Aureobasidium, Bacillus, Fusarium, and Trichoderma displayed significant levels of control over selected GTD pathogens. Inhibition assays against pathogens associated with Esca are currently underway, and future greenhouse and field trials will evaluate the efficacy of our biocontrol candidates.

Development of Low-Cost and Reliable Reaction Wheel for CubeSat Attitude Control

Timothee Galmiche
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Manufactured Reaction Wheel (MRW) component of the REALOP mission, UC Davis's first and completely undergraduate-led CubeSat mission. Reaction wheels are required by REALOP to point the satellite's visual and infrared spectrum cameras toward Earth and stabilize them to avoid motion-blur. The REALOP mission is developing low-cost and reliable reaction wheels for CubeSat application. These components are manufactured through the use of the student machine shop on campus, ensuring the cost-effectiveness and documentation of the manufacturing process. To mitigate risk of failure, reaction wheel prototypes will undergo extensive testing to verify that the design withstands launch loads and operates in the vacuum and temperature ranges of low Earth orbit for extended periods of time. Costs of commercial CubeSat reaction wheels typically exceed total budgets for university missions; successful demonstration and detailed documentation of REALOP's reaction wheel will provide university missions with a low-cost and reliable design, lowering barriers to entry to space and improving mission success.

Development of a Standardized Protocol for Brain Slice Registration to the Paxinos Brain Atlas

Swetha Ganesan
Sponsor: Diasynou Fioravante, Ph.D.
Neuro Physio & Behavior

Localizing manipulations and features of brain tissue sections is crucial to validate claims of anatomical and functional connectivity, and neurobiologists commonly achieve this goal by registering the tissue slices to reference images in a brain atlas. Numerous labs perform slice registration independently, creating the need for a standardized experimental and analytical platform to ensure reproducibility within and between labs. The protocol we are proposing involves perfusing and slicing brain tissue, imaging the slices, and mapping the images onto the Paxinos Brain Atlas to accurately localize sites of interest. Standardization is necessary at all stages of this process, and our focus is on optimizing the slicing and mapping stages. In the context of in vivo electrophysiological experiments investigating the connectivity between the cerebellum (CB) and nucleus accumbens (NAc) regions in mice brains, we applied our proposed method to verify electrode placement and injection target accuracy. Using the size and shape of characteristic brain regions, we overlaid slice images with reference maps to systematically register where the electrodes were placed in relation to the intended location and validate our claims of CB-NAc connectivity. Our proposed localization technique relates structural anatomy to functional connectivity, and a discussion of this protocol's efficacy is provided.

What's Going Down with Lettuce Downy Mildew Effectors? A Large Scale Screen of *Bremia Lactucae* Effector Proteins

Dasan Gann
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Many economically significant pathogens belong to the class of fungus-like microbes known as oomycetes. One of the most devastating pathogens of lettuce is the oomycete Bremia lactucae, also known as lettuce downy mildew. During infection, pathogens like B. lactucae secrete proteins called effectors into plant cells. These effectors have functions that vary from nutrient siphoning to suppression of host immune responses. Understanding how effectors interact with host cells is vital for developing crops that recognize and resist pathogen infection. In this project I aim to characterize the functions of a panel of B. lactucae effectors using transgenic lettuce lines expressing fluorescently tagged versions of each effector. I measured reactive oxygen species production of each transgenic line in presence and absence of an elicitor to assess the immune suppression capability of each effector. To elucidate the impact of effectors on virulence, I measured the severity of B. lactucae infection on the transgenic lines expressing the effectors compared to transgenic controls expressing only a fluorescent protein. I also visualized each tagged effector in planta using confocal microscopy to determine cellular localization of each effector. The results from these experiments will help uncover the complex roles these effectors play during infection.

Demographics and Volumetric Brain Change Models in an Ethnoracially Diverse Sample Better Predict Cognition in Some Ethnoracial Cohorts Than in Others

Bethany Gannon
Sponsor: Evan Fletcher, Ph.D.
MED: Neurology

Ethnoracial differences in brain and cognitive aging raise challenges for models of dementia incidence among diverse populations in the United States. One compelling example is the "immigrant paradox," in which recent immigrants often outperform non-immigrants. To examine this and other forms of variability, we evaluated associations of demographic factors and brain structural change on cognitive trajectories among ethnoracially diverse, aging adults. Four cohorts of older participants (n=20 Asian Americans, n=135 African Americans, n=127 Hispanics, n=250 Caucasians) with variable baseline cognitive statuses were sampled from the UCD Alzheimer's Disease Center database. Mixed-effect modelling was used to examine relations of brain and demographic factors to cognitive decline. Preliminary results reveal that models of cognition offer differing levels of explanatory power by cohort grouping. Longitudinal cognition variance in the Asian American and Hispanic cohorts is better explained than in the two others by the common set of demographic and brain change variables in our model. The discrepancy of explanatory power in our model suggests that certain groups may be more homogeneous than others, possibly reflective of some common factor in the Asian American and Hispanic cohorts. This may be related to the immigrant paradox.

Measuring Infant Crying in Infancy

Gabriela Ganoza
Sponsor: Lisa Oakes, Ph.D.
Psychology

The quality and quantity of infants' crying changes over development. However, conclusions about the development of crying requires valid and reliable methods to measure crying. Typically, measures of crying have relied on parental report. Advances in technology have allowed both the collection of naturalistic audio recordings of infant vocalizations and algorithms to process information from these recordings. For example, LENA, a company that produced high quality recorders and software to analyze recordings, report their algorithm correctly categorizes 84% of non-speech vocalizations (Xu, Yapanel, & Gray, 2009). Another study using the LENA algorithm reported 61% of non-speech vocalizations were correctly labeled (Rankine, Li, Lurie, Rieger, Fourie, Siper, Wang, Buxbaum, & Kolevzon, 2017). This discrepancy raises questions on the reliability and validity of the LENA algorithm. In a longitudinal study, we examined recordings from 40 infants approximately 6 months of age. Parents used LENAs to capture recordings over 3 days. The LENA algorithm automatically calculated how much infants' cried each day. In addition, parents maintained daily logs in which they reported their infants' crying. These two measures of crying allow us to compare the reliability and validity of the LENA algorithm to parental report measures, which is crucial in understanding limitations of these methods.

Oral Retellings in Spanish and English: An Exploratory Study with DLLs in Kindergarten

Daniela Garcia
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Recent research on the language and literacy development of Dual Language Learners (DLLs) has used standardized measures to document language skills. However, although research suggests that oral retelling may provide better insights into DLLs' oral comprehension and proficiency than standardized measures, many studies have not examined the oral retelling skills of DLLs in both home language and English. In this exploratory study, we gathered narratives of Spanish-English DLLs who were enrolled in a dual language immersion program. A total of 11 DLL kindergarteners were asked to listen to "Frog Where are You" in English and "Frog Goes to Dinner" in Spanish while looking at the pictures in the book, and asked to retell the story in the respective languages on two separate days. Data was collected at the beginning of the school year and again at the end of the first semester. Narratives were coded for structure and calculated for the total number of words and number of different words. Results show that overall children performed better in English than Spanish on both pre- and post-tests on the oral retellings. Results suggest that more focus on the retention of the Spanish language is needed to maintain the DLLs' home language.

Sustainable Real Vegan Cheese Production by Recombinant Casein Expression With *Kluyveromyces Lactis* to Address Global Dairy Industry Environmental Impacts

Philip Garcia
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Raw milk production and cattle farm waste are responsible for the majority of the dairy industry's negative environmental impact and high CO_2 emissions. In an effort to reduce the impacts of the global industry, the Real Vegan Cheese (RVC) Project is researching the production of vegan cheese nearly identical to traditional cheese in an environmentally sustainable and economically viable way. Our research focuses on genetically altering the yeast organism Kluyveromyces lactis to express four common bovine casein proteins - Alpha-S1, Alpha-S2, Beta, and Kappa. These proteins are the major proteins found in milk that precipitate into cheese curds when treated with the enzyme chymosin. To date, we have successfully constructed four vector plasmids, each containing genes encoding one of the four casein proteins of interest. We report our current efforts and early results to transform and express these genes in our yeast expression strain K. lactis. The Real Vegan Cheese Project is part of BioInnovation Group, which is one of the first undergraduate-run research organizations at UC Davis providing undergraduate students with collaborative and innovative research experience.

Evaluation of Anti-Epileptic Drug Discontinuation in the Veteran Population with Focal Onset Epilepsy at the Veterans Affairs Greater Los Angeles Medical Center

Neha Gautam
Sponsor: Grace Rosenquist, Ph.D.
Neuro Physio & Behavior

In the United States, epilepsy affects approximately 5 in 1,000 individuals. Epilepsy is associated with reduced quality of life, higher rate of premature death, increased injuries and psychological illnesses. The goal of treatment is to decrease or stop seizures while minimizing side effects of Anti-Epileptic Drugs (AEDs). Multiple studies examining the retention rates of AEDs in patients with epilepsy have been conducted. There is a paucity of information on the discontinuation rates of AEDs and the reasons for discontinuation. The objectives of our study are to determine which AEDs are most likely to be discontinued and the reasons for discontinuation. We conducted a retrospective chart review of all veterans with focal epilepsy seen in clinic from 7/1/2008 to 6/30/17. Baseline characteristics and following data points were collected: presence of traumatic brain injury (TBI), discontinued AEDs, and reason for discontinuation. The top 3 discontinued AEDs were phenytoin (PHT), valproate (VPA), and levetiracetam (LEV). Of the 179 patients tried on PHT, 149 were discontinued. Of the 90 patients tried on VPA, 68 were discontinued. Of the 168 patients tried on LEV, 61 patients were discontinued. For PHT, VPA and LEV the top known reason for discontinuation was the presence of side effects.

Transcript Validation for a Novel Androgen Receptor Variant, BI-V1, in Bladder Cancer

Chuwen Ge
Sponsor: Maria Mudryj, Ph.D.
MED: Medical Microbiology & Imm

Bladder cancer is the sixth most commonly diagnosed cancer worldwide, with three out of four new cases occurring in men. A potential reason for this gender disparity is the androgen receptor (AR), a ligand-dependent transcriptional factor that binds androgens, mainly testosterone and its metabolite 5alpha-dihydrotestosterone (DHT). Androgens function in a DNA dependent manner to regulate target genes at the transcriptional level. Some tumor cancer models, however, have an increase in AR splice variants, a regulated process during gene expression that results in a single gene coding for multiple proteins. Some of these variants lack a ligand binding domain, but can still bind to DNA and activate transcription. We have isolated and characterized a mutated AR variant, BI-V1, in human bladder cancer cell lines. In previous studies, RNA-seq was used to identify transcript changes of the AR-dependent transcrptome by depleting total AR BI-V1 and overexpressing BI-V1 and overexpressing BI-V1 in the UM-UC-3 cells. This study verifies those specific RNA-seq transcrits through qPCR of AR and BI-V1 knockdowns in UM-UC-3 bladder cell lines.

Paternal Experience-Dependent Changes in Infant-Induced Neural Activity Across Time

Jacqueline Geyfen
Sponsor: Danielle Stolzenberg, Ph.D.
Psychology

At birth, mammalian females become highly responsive to infants and this motivation is sustained long-term. Since most females are relatively avoidant of infants prior to giving birth, this transition is useful for studying experience-dependent plasticity. The medial preoptic area (MPOA) of the anterior hypothalamus serves as the main neural site for parental care. The MPOA coordinates parental behavior by blocking neural activity in pathways involved in the regulation of avoidant behavior allowing infants to activate neural pathways involved in motivation. Presumably, the transition from the non-maternal to maternal state involves alterations within these pathways, although how the activation of these pathways change as a function of experience is entirely unknown. Further, attempts to understand experience-dependent plasticity have examined differences between naïve and experienced subjects rather than identifying changes across time within the same subject. Until very recently, understanding experience-dependent plasticity at the neuronal level has been impossible. Here, we use new technology that allows us to (1) determine the extent to which the cells that are activated in the non-maternal state overlap with the cells that are activated in the maternal state and (2) determine the extent to which the same cell population maintains responsiveness toward infants long-term.

Transient Expression of *Arabidopsis* zDof1.3 in Tomato Seedlings (Solanum lycopersicum L.)

Xiuhoon Giang
Sponsor: Diane Beckles, Ph.D.
Plant Sciences

Tomato is one of the most popular vegetables in the world. Attempts to increase yield to meet increased demand of consumption by investigating Transcription Factors (TFs) have been made. AtzDof1.3 (Arabidopsis thaliana DNA Binding with One zinc Finger 1.3), a TF, appeared to have changed the carbon and nitrogen relationship in stable ectopic expressed tomato lines, leading to higher yield than wild type. In this study, we are verifying this using a transient expression system. The effect of AtzDof1.3 on starch and protein metabolism in tomato seedings will be examined. AtzDof1.3 was cloned from Arabidopsis genomic DNA and inserted into an overexpression construct fused with green fluorescent protein (GFP). Transgenic tomato seedlings were selected by visualizing the GFP marker, and the expression level of AtzDof1.3 and its target genes will be determined by RT-PCR. Qualitative and quantitative assessment of starch from Dof seedlings will be done by using iodine visual marker and biochemical measurement respectively. This research might serve as a rapid way to assess the effects of TFs on primary metabolism in plants.

The Role of Innate Immunity in Bone Mass Regulation

Adrienne Giannone
Sponsor: Damian Genetos, Ph.D.
VM: Anat Physio & Cell Biology

A class of cells in bone, termed osteocytes, are important in coordinating bone growth and loss. There are many signaling pathways in osteocytes important in maintaining local and regional skeletal homeostasis. Recently, a link between two osteocyte pathways—one involved in bone formation (Wnt/ß-catenin signaling) and the other in innate immune responses (NOD1/NOD2 signaling)—was established. Wnt/ß-catenin signaling involves the binding of Wnt ligands to a membrane-bound receptor complex, consisting of the LYPD6 receptor and the LRP5/6-Wnt coreceptor, whereas NOD1 and NOD2 are cytosolic receptors that bind to pathogen-associated molecular patterns derived from bacteria. Activation of the LYPD6-LRP5/6 complex connects NOD1/NOD2 signaling to Wnt/ß-catenin signaling; however, the specific impact of NOD1/NOD2 on Wnt/ß-catenin signaling has not been studied in osteocytes. Therefore, we sought to quantify the impact of LYPD6-LRP5/6 and NOD1/NOD2 signaling by tracking Wnt/ß-catenin gene expression under separate conditions. Osteocytes were dosed with varying concentrations of a Wnt agonist (Wnt3a), in the absence or presence of a fixed mass of NOD1 agonist (iE-DAP) or NOD2 agonist (MDP). We found that NOD1 and NOD2 synergistically and reciprocally regulate Wnt/ß-catenin signaling. Our results and discussion aim to establish the mechanisms by which innate immunity influences bone matrix maintenance and vitality.

Development of a Hydrogel Bioreactor for Cost-Effective Extraction of BChE from Transgenic Rice Cells

Christine Gichigi
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The global bioprinting market is expected to reach over 4.1 billion USD in value by 2026. This explosion of the bioprinting industry includes using techniques like encapsulation of cells in alginate-based hydrogels. These hydrogels can be used as bioreactors for both cell growth and simplified protein extraction. Our team uses hydrogels with rice cells that were engineered to produce tetrameric BChE, a complex human serine hydrolase enzyme that provides protection against organophosphorus poisoning. This particular form of BChE has previously only been found in expired human blood plasma and costs over $10,000 to produce per treatment. By combining hydrogel encapsulation technology, a low-cost bioprinter, and transgenic rice cells, our group is working to develop a method of extraction that reduces the cost of producing this protein. To determine if hydrogel encapsulation is an effective way to extract BChE from transgenic rice cells, we ran repeated Ellman assays to quantify the levels of BChE present in solution over time. To determine if this would be a viable long-term solution to reduce extraction costs from the process of purification, we ran TTC cell viability assays to determine how prolonged exposure to gel affects cell growth and viability.

Effect of Naturally Occurring Genetic Variations in Incretin Receptors on Glucose Homeostasis

Harnoor Gill
Sponsor: Jennifer Whistler, Ph.D.
MED: Physiology & Membrane Biol

Glucose homeostasis is important for human health, and maintained by the combined actions of insulin and glucagon hormones secreted by pancreatic beta and alpha cells. Insulin secretion after eating is also regulated by incretin gut hormones: glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP). GLP-1 and GIP stimulate insulin release from beta cells by their action on their associated G protein-coupled receptors (GPCRs): GLP-1R and GIP-R. The enhanced insulin secretion highlights the insulinotropic effects of incretins (incretin effect), which characterize them as important therapeutic targets for maintaining glucose homeostasis. Naturally occurring genetic variations in incretin receptors are known to affect insulin secretion in humans. Literature evidence and preliminary data from our lab have shown that GLP-1R variant R131Q increases while G168S variant decreases the incretin effect. Similarly, a GIP-R variant E354Q is associated with decreased incretin effect. This study aims to identify the molecular mechanisms that account for the altered insulin secretion associated with genetic variations in incretin receptors. My role in the project is to generate GIP-R variants E354Q and A207V using HEK-293 cells, which will be used to determine alteration in ligand binding, G-protein activation and post-endocytic sorting due to these genetic variations that can affect glucose homeostasis.

Optimizing Plastic Biodegradation Pathways via PETase Enzymes

Isabella Glenn
Sponsor: Nitzan Shabek, Ph.D.
Plant Biology

Plastic persistence in our environment, has resulted in a vastly deleterious effect on both terrestrial and marine ecosystems. Every year ~300 million metric tons of plastic are produced. This synthetic material is disposed of via recycling, landfilling, or incineration. While recycling has been a partial solution by repurposing plastic, a more permanent solution awaits to be discovered. In the past decade, scientists have been exploring the possibility of plastic biodegradation by breaking down plastic polymers into organic compounds. A plausible solution was found with the recent discovery of plastic-degrading-bacteria, Ideonella sakaiensis, that utilizes a catalytic enzyme called PETase. Although PETase effectively metabolizes polyethylene terephthalate (PET, one of the most common plastic polymer) to generate organic molecules, the hydrolysis reaction rate is extremely slow. Additionally, this enzyme requires a thermal stable environment for PET catalysis. The main goal of this study is to design a molecular and biochemical platform to optimize and accelerate the catalytic function of PETase. Here, we present the molecular cloning of PETase enzyme in bacteria. We produced PETase protein and begin to study its function in vitro. This study provides the foundation for large-scale mutant analysis towards optimization of plastic eating bacteria.

Methods to Assess Postural Responses to Unexpected Tilting Perturbations

Miranda Godinez
Sponsor: Karen Moxon, Ph.D.
Biomedical Engineering

Understanding how animals maintain posture in response to postural perturbations is important for understanding how the nervous system maintains postural control. Previous studies used rabbits and cats to study the impact of neurological injury or disease on that control. Rats are an excellent model to test therapeutic interventions after spinal cord injury (SCI), however, little is known about how rats respond to postural perturbations. To that end, the current study is investigating the effect of unexpected perturbations on postural control by measuring changes in the center of pressure. Three six-axis force-torque sensors were embedded in a platform that could tilt in one plane for varying amplitudes and durations. When a rat was placed on the platform such that the tilt occurred in the lateral plane, ground reaction forces (GFRs) were recorded. The GFRs were used to calculate changes in the center of pressure as the animal worked to maintain its balance during tilts. Changes in the center of pressure will be used to identify strategies the animal uses to maintain balance in response to the tilt. Future studies will assess the impact of SCI and different therapeutic interventions on this postural control.

Investigating Isolation Procedures of Pure Human Secretory Immunoglobulin A from Donor Milk

Sarah Goldberg
Sponsor: David Mills, Ph.D.
Viticulture & Enology

Necrotizing enterocolitis is a devastating disease afflicting over 5% of preterm infants (<33 weeks gestation) in developed countries, with high morbidity and mortality. Bioactive proteins in breast milk, including immunoglobulins, can reduce the incidence of disease by shaping the microbial community in the susceptible infant gut. A recent study has demonstrated the importance of milk secretory IgA (sIgA) in the prevention of disease development; however, this protection is markedly reduced in infants fed donor milk as processing degrades the bioactive molecules. This project aims to determine the most efficient strategy to isolate pure human sIgA from donor milk without harming the macronutrient levels or bioactivity of human donor milk through two alternate protocols, affinity chromatography extraction or magnetic bead sorting. An anti-human sIgA ELISA was used to quantify sIgA in donor milk. Donor milk was defatted by high speed centrifugation prior to affinity chromatography. Both defatted and whole milk were used in the magnetic bead isolation method. The purity of the extracted product was validated by SDS-PAGE. This product has potential use in downstream animal studies and human clinical trials on sIgA provision in premature infants in the prevention of necrotizing enterocolitis.

Queer Christians do not Always do Queer Interpretation: Hermeneutical Differences Between Gay Christian Men and Transgender Christians

Kenton Goldsby
Sponsor: Ewa Mroczek, Ph.D.
Religious Studies

Recent interpretation of Christian doctrine and the Bible by lesbian, gay, bisexual, transgender and queer (LGBTQ) individuals does not represent a singular voice. In fact, different groups under the LGBTQ banner have varied rhetorical goals when conducting interpretation. I argue that gay men and transgender people, as two different groups, occupy two distinct hermeneutical or interpretive spaces. Gay men are rooted in LGBT interpretation which focuses on apologetics, also thrusting them into an assimilationist position in the Christian LGBTQ community. This is a position they remain in to this day, as seen through the recent work by David and Constantino Khalaf, who maintain the same rhetorical goals as another recent gay man author, Matthew Vines. On the other hand, transgender Christians interpret through a queer theory/queer criticism-based model. In this model, "queering" scripture and rejecting heteronormativity are the focal points of interpretation. I propose that this model of interpretation is seen through a recent work of transgender, Christian authorship: the book Transforming by Austen Hartke.

"You're here to learn, right?": Undergraduates Ask Provocative Questions About Learning

Laura Gomez
Sponsor: Kara Moloney, Ph.D.
Educ Effec Hub

The Curious Aggies project engages students in efforts to promote transparency and inclusivity in campus discussions about how to improve student learning. Co-designed and conducted by student assessment researchers, the purpose of the project is to identify the extent to which learning outcomes are transparent to students at a large, public, research university. In this academic presentation, undergraduate Student Assessment Fellows will present results from their student-led inquiry project. During the pilot, a Student Assessment Fellow asked a random sample of 50 undergraduates through either an in-person interview or an online survey 1) how they know what faculty expect them to learn; and 2) how they find out what faculty expect them to learn. The Student Assessment Fellows conducted a content analysis, and found that 66% of participants (n=35) determine instructors' expectations from the course syllabus; 34% (n=18) will ask someone, and perhaps most notable, that 21% (n=11) said that they find out after receiving a grade on a test or assignment. The findings raise provocative questions, including the degree to which course syllabi actually include learning outcomes; the sources to whom students turn to discover instructor expectations; and ultimately, how legible faculty expectations are to students.

The Role of Aurora B Kinase in Replication Stress-Induced Nucleophagy

Joseph Gonzales
Sponsor: Kenneth Kaplan, Ph.D.
Molecular & Cellular Bio

Coordination of sister-chromatid resolution with cell division events during anaphase is critical for genome integrity. A key regulator of these events is the Aurora B kinase, which in addition to its known roles in regulating spindle microtubules and chromatin, may inhibit abscission during cytokinesis by negatively regulating ESCRT-III, a complex of proteins involved in membrane closure. ESCRT-III function is also required during nuclear envelope assembly and for the formation of autophagic vesicles, where it has been suggested to be part of a nucleophagy surveillance pathway that targets micronuclei during anaphase for destruction in the vacuole/lysosome. Evidence suggests that under conditions of replication stress, nucleophagy is activated, but how ESCRT-III is regulated during nucleophagy in anaphase is unclear. We hypothesize that the Aurora B kinase regulates ESCRT-III and nucleophagy in the presence of unresolved sister chromatids induced by replication stress. To test this, we will induce replication stress with hydroxyurea and chemically inhibit an analogue sensitive allele of Aurora B in budding yeast and measure ESCRT-III function. We predict that Aurora B activity is required to inhibit ESCRT-III processing of autophagic membranes under these conditions and will give rise to an accumulation of vesicular intermediates.

Collagen Alignment Scales with Skeletal Muscle Passive Stiffness in the Extensor Digitorum Longus from Dystrophic Mice

Gabriella Gonzalez
Sponsor: Lucas Smith, Ph.D.
MED: Physical Medicine & Rehab

Skeletal muscle fibrosis is linked to many neuromuscular diseases, prominently including muscular dystrophies. Fibrosis contributes to the degradation of muscle function with excess passive stiffness and the formation of contractures. However, reports have shown that the amount of fibrotic material does not scale with the muscle stiffness. Thus, we hypothesized that features of fibrotic material organization, namely collagen alignment, result in excessive stiffness in mdx muscle, a mouse model of Duchenne dystrophic mice. Sirius red staining and polarized light microscopy were used to identify the orientation of collagen alignment at a micro and macro scale. Muscle stiffness was measured using mouse whole muscle mechanics. We found in the EDL muscles of mdx mice that stiffness tended to increase with collagen micro-alignment, which was not present in the soleus muscle. For both wildtype muscles, stiffness was significantly correlated to macro-alignment as hypothesized. Surprisingly for mdx muscles, the relationship was reversed with macro-alignment leading to decreased stiffness. It is possible that collagen stiffness in mdx muscles is made up of structurally different components that thus contribute to the differential effects, in which more research will be needed to investigate the structures that assist in muscle stiffness in fibrosis.

Comparison of *In Vitro* Platforms Used to Predict the In Vivo Response of the Rumen Microbiome

Maria Gonzalez
Sponsor: Matthias Hess, Ph.D.
Animal Science

Ruminants rely on symbiotic microorganisms (i.e. bacteria, protozoa, archaea, anaerobic fungi) to digest highly recalcitrant plant biomass. While some of these symbionts digest cellulose and hemicellulose for host nutrient utilization, other microbes found in the rumen synthesize needed metabolites and offer resistance against pathogenic invaders. Given the importance of this relationship, understanding how microbes in the rumen modulate host health and performance is key to improving the efficiency and well-being of these animals. Growing interest exists in testing novel feed additives, diets, and therapeutics that may affect the composition and function of the rumen microbiome. Recently the scientific community has developed interest in discovering efficient methane mitigation strategies that may reduce greenhouse gas emissions stemming from ruminant animals in the livestock industry. The use of artificial models enable researchers to efficiently test the effects of novel compounds and allows for a better understanding of microbial community interaction without relying on large numbers of animals. In vitro systems currently established vary in complexity, ease of operation, maintenance, and reliability of the generated data. This study aimed to compare various in vitro rumen models to determine which can be used to most reliably depict in vivo microbial community function.

Examining Changes in Perception of Science Relevancy and Student Career Aspirations Through Integrating Socio-Scientific Issues into General Chemistry Curriculum

Kaanan Goradia
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Students perceive chemistry as a high-level and perplexing subject. Many students fear just hearing the word, “chemistry”. Increasing motivation and making chemistry relevant to students’ life are important goals in chemistry education and are meant to alleviate this stress. This project’s goal is to explore the influence of socio-scientific issues such as Nanotechnology and Alternative Energies on changes in students’ career aspirations and attitudes towards the relevancy of science. Two different learning environments on these topics were prepared using Prezi. Relevant sustainability-oriented content was introduced as a part of the information presented with a focus on the United Nation Sustainable Development Goals, along with other global perspectives. The study was completed in three steps. First, students were asked to take pre-intervention surveys and explore the learning environments. Afterwards, during the discussion session, they debated on these topics by assuming real world careers, like economists, scientists and health safety experts. In the last step, they completed post-intervention surveys and highlighted discussion points. Analysis of students’ comments and T-tests have been performed to identify statistically significant differences and connect results with demographics, which help conclude whether such interventions are effective in influencing students’ attitudes and career aspirations and which groups are benefitted most.

Spatial Organization of Mitochondrial Inner Membrane Subdomains

Kaitlynn Gov
Sponsor: Jodi Nunnari, Ph.D.
Molecular & Cellular Bio

The mitochondrial inner membrane is an essential platform that conducts and integrates key cellular pathways, including oxidative phosphorylation. As such, the inner membrane is protein-dense and highly organized into at least three morphological and compositional domains: cristae, boundary regions, and cristae junctions. Based on localization of a small fraction of the inner membrane proteome, it is thought that the respiratory machinery are localized to cristae while solute transporters are enriched in boundary regions. To test this model and gain insight into mechanisms underlying domain sorting of inner membrane proteins, we systematically determined the subdomain localization of a majority of inner membrane-associated proteins in budding yeast, resolving their localization by expanding the diameter of mitochondria in vivo. Our results indicate that a majority of GFP-tagged inner membrane proteins localize to cristae and a majority of respiratory and solute transporters localized to cristae and boundary regions, respectively. However, there were a number of exceptions, including cristae-localized solute transporter Yea6. To understand the properties of inner membrane domain sorting, we are examining cis determinants of Yea6 required for its subdomain localization. Our data suggest a simple model where boundary and cristae regions are generated by retention of a majority of proteins in cristae.

Investigating Compatibility Effects for Paper vs Screen Recall

Marialisa Grassa
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Nowadays, it is a common practice amongst college students to purchase e-books instead of hard-copy textbooks for learning. Current research is undecided whether reading information from paper is more beneficial than reading information from a screen. To determine whether students’ memories are influenced by the type of medium used when learning, we tested UC Davis undergraduates in groups of 1-4, using two SAT passages. Students read, highlighted and took notes of one passage on paper and the other on screen. After a 48-hour delay, students were tested either on paper or screen for their recall of the original passages. We predicted that students who read and test on the same medium will have higher recall scores for the passages (“the compatibility effect”), than students who read and test on different mediums. Furthermore, recall scores will be higher for the paper-paper condition versus screen-screen condition. Preliminary results on 62 participants suggest that when students study and test on paper they have higher recall scores than when they study and test on screen; compatibility effects are present only when students study on paper. This research is important because students may want to consider studying on paper despite growing popularity of electronic textbooks.

BioInnovation Group's Algae to Insulin Project: *Chlamydomonas* reinhardtii Chloroplasts as a Sustainable Biomanufacturing Platform

Daniel Graves
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Biomanufacturing plays an ever increasing role in our society, responsible for creating products ranging from therapeutics to industrial chemicals to food products. However, the most popular chassis organisms in synthetic biology require large amounts of sugars, amino acids, and frequently, antibiotics and animal extracts. These inputs carry significant financial and environmental costs. Chlamydomonas reinhardtii is a single-celled eukaryotic algae whose chloroplast has been shown capable of producing therapeutic-grade proteins. C. reinhardtii is capable of photosynthesis, and requires as inputs only trace inorganic salts, a buffer, and a simple nitrogen source. We report our progress towards investigating the environmental sustainability of C. reinhardtii as a protein production platform, and our progress towards genetic construct design and algal strain engineering with mini-proinsulin as our primary candidate protein. As a BioInnovation Group at UC Davis research project, this project is entirely undergraduate run, and represents a new mode of expanding undergraduate co-curricular biotechnology education.

Improving the Efficiency and Accuracy of Hybrid Finite Element / Particle-In-Cell Methods for Modeling Geologic Processes in the Earths Interior

Mack Gregory
Sponsor: Elbridge Puckett, Ph.D.
Mathematics

In computational models of the Earth's mantle it is necessary to follow the movement of quantities (e.g., density or viscosity) as the computation evolves in time. Often this movement is modeled as particles, which carry a given value of the quantity on each particle and move with the underlying flow field. These values are then interpolated onto an underlying grid, on which other quantities in the model are computed. To date the interpolation has either been based on averaging the values of the particles or forming a linear approximation to these values and interpolating onto the cell. However, to maintain the design accuracy these algorithms require the number of particles per cell (PPC) to increase as the cell width h goes to zero. We have developed a quadratic least squares interpolation algorithm, which achieves the design order of convergence with a small, fixed number of PPC as h goes to zero. We have measured the accuracy and efficacy of our methodology by computing several of the standard benchmarks in computational geodynamics. We achieve the same level of accuracy with a small, constant number of PPC as other codes do when run on the same problem without particles.

Determining if Subtle Reproductive and Molting Seasonality Exist in a "Continuous Breeder"

Jennifer Guerra
Sponsor: Rebecca Calisi, Ph.D.
Neuro Physio & Behavior

Most organisms must consider temperature, food, water availability and photoperiod when timing their optimal breeding season. Unlike many seasonally-breeding birds, rock pigeons (Columba livia) are labeled as "continuous breeders", a species breeding year round. Also, unlike birds who experience seasonal molting, a periodic shedding of old feathers, rock pigeons are said to experience "continuous molting". However, these binary label designations may fail to acknowledge the presence of a potential continuum of reproductive seasonality and molting. Thus, due to the behavioral differences and energetics associated with these processes, it is important for labs who use this model to determine if any subtle patterns exist, as they could influence experimental outcomes and data interpretation. We examined incidence of breeding and molting in our lab's captive colony from 2016-2019, which included statistically testing for changes in 1) the number of eggs laid and chicks hatched, and 2) the presence of primary and secondary wing feathers throughout the year. Controlling for food and water, we hypothesized that as the ambient outdoor temperature increases, the fecundity of rock pigeons will increase, and incidence of molting will decrease accordingly. Consequently, these findings will help researchers efficiently fine-tune future breeding experiments using captive birds in semi-natural environments.

Influence of Plate Speed Perturbations on Mantle Plume Formation and Buoyancy Flux

Veronica Guerra
Sponsor: Maxwell Rudolph, Ph.D.
Earth And Planetary Sciences

Mantle plumes are thought to produce the largest outpourings of basaltic magma in Earth's history and have been linked to mass extinction events. However, the mechanisms responsible for mantle plume formation are not yet fully understood. Understanding plume behavior and how mantle properties affect their dynamics is key to ascertaining their role in mantle heat transport and hotspot volcanism. We created 2D numerical models to study mantle plume formation and movement. Plume dynamics can be affected by variations in plate speed, so we investigated the influence of the amplitude and periodicity of plate speed perturbations, as well as Rayleigh number. We calculated the plume buoyancy flux (amount of heat transported) and the phase lag between plate speed and buoyancy flux variations. There is a correlation between plate speed perturbation and buoyancy flux that weakens with increasing Rayleigh number. We also found that the phase lag generally decreases with increasing amplitude and with decreasing period of plate speed perturbations. Our results support the idea that variations in plate motions are fundamental to the formation and heat transport of mantle plumes.

Tracing the Historic Record of Vicuña Use in the Andes

Isabelle Guerrero
Sponsor: William Haas, Ph.D.
Anthropology

Vicuña (Vicugna vicugna) are a small camelid species found across the Andean altiplano. Their wool is a highly prized commodity, valued for its silkiness and ability to insulate. While humans and vicuña have a longstanding history of interactions from early hunter-gatherer groups to later large-scale empires, most knowledge of vicuña management comes from Inkan chaccu hunts and contemporary government-sanctioned roundups. In the centuries following colonization, the vicuña suffered a major population decline, and though their numbers now stable and sustainably managed, the drivers of this ecological catastrophe are still not well understood. This research centers on questions such as: Why were vicuña rapidly declining during the colonial and post-colonial eras? Why are vicuña seldom discussed within the historical record? What kinds of commodities were being made from vicuña wool, and was there a market for these products? By examining and analyzing academic literature, colonial accounts, archaeological data, and ethnographic material, this paper aims to shed light on these unanswered questions regarding the relationship between humans and the vicuña.

Effect of Anaerobic Composter Systems on the Degradation of Plastic in Food Packaging

Konane Gurfield
Sponsor: Maureen Kinyua, Ph.D.
Civil & Environmental Engr

Increased food waste is accompanied by excessive food packaging waste. Although food packaging is often compostable, its degradation rates are slow. The purpose of this research is to evaluate the effect of microaerobic conditions on plastic degradation, in search of optimal composting conditions. During the first trial, equal amounts of plastic and fibrous compostable squares were placed into two different conditions of a cow manure/water solution - one anaerobic and one with intermittent airflow - to test the effects of anaerobic versus microaerobic conditions on plastic degradation. In four day increments, plastic samples were removed from the reactors and their change in weight was calculated. The first trial of this experiment concluded that an introduction of low oxygen concentrations resulted in a higher rate of plastic degradation for both types of compostable food packaging as compared to anaerobic conditions. The operation of microaerobic composter systems may provide faster rates of plastic degradation; however, further research is required to understand the underlying mechanisms of these results.

Contribution of Somatostatin in Controlling Mature Beta Cell Function

Jaresley Guillen
Sponsor: Mark Huising, Ph.D.
MED: Physiology & Membrane Biol

Pancreatic beta and delta cells coordinate through various cross-talk mechanisms to establish a normoglycemic setpoint. For example, delta cell-secreted somatostatin is crucial for attenuating insulin secretion from beta cells. Interestingly, adult mice exhibit a higher glycemic setpoint than neonatal mice. This is likely due to the expression of Urocortin 3 by mature beta cells in adult mice, which triggers somatostatin secretion to provide negative feedback to beta cells. The goal of my project is to investigate the mechanism by which somatostatin affects mature beta cell function and expression with the underlying hypothesis that somatostatin contributes to mature beta cell function by increasing the glucose response threshold and promoting beta cell maturation. To test how somatostatin affects the glucose response threshold, I am comparing mice that do not express somatostatin to mice that do, with both expressing the calcium reporter GCaMP6 in both beta and delta cells. This will allow me to assess the calcium response of both beta and delta cells within live, intact islets to increasing glucose levels using confocal microscopy. To explore the role of somatostatin on beta cell maturity, I will investigate differential expression of beta cell maturity genes such as Ucn3, MafA, and Glut2 using qPCR.

Building a Novel FRET Sensor for G Protein Signaling in Inflammatory Response

Annalise Gushue
Sponsor: Sean Collins, Ph.D.
Microbiology & Molec Genetics

Neutrophils are crucial cells within the innate immune system and represent the first line of defense against a range of pathogens. Inflammatory cues are received by G-protein-coupled receptors and activate intracellular heterotrimeric G proteins containing $G\alpha_i$ and Gßγ subunits. G protein signaling is necessary to mount pro-inflammatory neutrophil behaviors, but our understanding of the spatiotemporal regulation of these signals is limited. FRET (fluorescence resonance energy transfer) biosensors have been developed to study G protein activities in live cells; however, existing bi-molecular FRET sensors have variable component stoichiometries, so cannot be used for rigorous quantitative analysis. To resolve this, I have developed a novel unimolecular FRET sensor that will enable quantitative live cell imaging of G protein signaling dynamics and I have begun characterizing this sensor in a neutrophil-like cell line called PLB-985. These studies will help elucidate the temporal and subcellular spatial dynamics of G protein signaling during neutrophil responses to inflammatory cues. Further, the proposed biosensor could aid in the study of processes controlled by G protein signaling in other biological contexts, such as cancer cell migration and hormone signaling in diabetes.

The Effect of Exercise Therapy on Locomotor Recovery after Incomplete Spinal Cord Injury

Vanessa Gutierrez
Sponsor: Karen Moxon, Ph.D.
Biomedical Engineering

Approximately 17,000 new cases of spinal cord injury (SCI) emerge every year in the United States, however few treatments exist for this debilitating condition. Previous research in both humans and animal models showed that exercise therapy is an important intervention following a severe SCI, but limited information is available on the benefits of exercise after moderate injuries that do not result in complete paralysis. To assess this, a subset of animals were given five weeks of treadmill exercise therapy following a mid-thoracic spinal cord contusion that impaired lower limb coordination during locomotion. Recovery of lower limb coordination in the exercise therapy group was compared to that of a group that received a similar injury and was handled a similar amount of time, but not given treadmill therapy. Results show that exercised animals recovered a higher degree of weight supported stepping and limb coordination than non-exercised animals. This finding highlights the importance of exercise therapy for the treatment of SCI and lays the groundwork for future studies that investigate the combination of exercise with other therapeutic interventions after SCI.

Development of Flight Software and Analysis Tools for CubeSat Attitude Determination and Control System

Alayna Guyser
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS software development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Flight software is developed to determine and control the attitude or orientation of the CubeSat by integrating sensor data and giving commands to the hardware. The attitude determination algorithm, TRIAD, is developed to integrate sensor data with mathematical models to output the state of the satellite. The output is used by B-Dot and PD, which are closed-loop algorithms allowing the hardware to stabilize the satellite and point the cameras towards Earth. Integrated software and hardware testing is performed to verify that the system meets requirements. A virtual model of the CubeSat, VirtualSat, is also in development to simulate the in-orbit motion of the satellite, while taking external factors like drag, solar radiation, etc. into account. VirtualSat will be an open-source tool that will allow other missions to visualize spacecraft dynamics and develop control algorithms.

Formation of Secondary Organic Aerosols through the Oxidation of Phenols

Chrystal Guzman
Sponsor: Cort Anastasio, Ph.D.
Land Air & Water Resources

Human carbon emissions have impacted the atmosphere-changing what chemicals are present, how long they remain in the air, and how compounds are removed. These chemicals are most often processed by oxidants, such as hydroxyl radicals, which can transform them into secondary organic aerosols (SOAs). Our laboratory investigated the role of a less considered oxidant, triplet excited states ($^3C^*$) of organic compounds, in generating SOAs under aqueous conditions. Some aromatic compounds, similar to those released in wildfires, can easily partition into water droplets and react with oxidants. Thus, we exposed six phenolic compounds to $^3C^*$ molecules and UV-radiation to induce photochemical reactions and determined their second-order rate constants. These rate constants are needed to determine the lifetime of molecules in our atmosphere. Our results indicated that reactions in lower pH conditions, phenols with methoxy groups, and phenols with greater quantities of functional groups accelerated rate constants and formed SOAs more quickly. These results have implications in environments with high concentrations of $^3C^*$, such as near biomass burning sites. Greater quantities of SOAs may be generated than previously recognized, affecting both the environment and human health.

Purification and X-Ray Crystallography of the *Mycobacterium Tuberculosis (Mtb)* Bifunctional CGL/CGS Enzyme MetB

Macy Ha
Sponsor: Andrew Fisher, Ph.D.
Chemistry

According to the WHO, Tuberculosis is one of the top 10 causes of death worldwide. Almost 500,000 people contracted drug resistant Tuberculosis in 2018. This leads to the need for alternative drug targets against Mycobacterium tuberculosis (Mtb), the pathogen responsible for the disease. The enzyme MetB is a potential drug target because of its integral part in the metabolism of sulfur-containing compounds which is necessary for Mtb survival. MetB is a bifunctional enzyme, possessing both cystathionine γ-lyase (CGL) and cystathionine γ-synthase (CGS) activities. This bifunctionality is unique to MetB and is not found in human enzymes. Using X-ray crystallography, we aim to visualize and understand the mechanism of how the enzyme functions in order to one day aid in the development of an inhibitor. We are currently expressing recombinant His-tagged MetB in E. coli and optimizing a purification method in order to produce pure protein for crystallization trials. We have also developed an activity assay to determine the functionality of our construct. We found that MetB purifies well under denaturing conditions and the purified enzyme retains its ability to turn cystathionine into cysteine. We plan to conduct high-throughput crystallization screens in order to obtain appropriate crystals for X-ray diffraction.

Determining the Role of Protein Kinase D in ß-AR Signaling

Nima Habibi
Sponsor: Julie Bossuyt, D.V.M.,Ph.D.
MED: Pharmacology

Protein kinase D (PKD) is a stress activated kinase implicated in cardiac remodeling and heart failure. Several groups have shown that the ß-adrenergic signaling pathway, which mediates our fight-or-flight response, can also modulate PKD signaling. However whether PKD can reciprocally affect the ß-adrenergic signaling pathway is unknown. To determine this, we focus our attention towards cyclic adenosine monophosphate (cAMP). A secondary messenger of the ß-adrenergic signal transduction pathway, changes in cAMP concentration are indicative of adrenoceptor function. Here we use next-generation, FRET-based cAMP biosensors (CUTies) to monitor cAMP levels. Furthermore, the CUTies report in distinct nanodomains through the use of AKAPs, providing spatial specificity to the cAMP signal. After expression in cultured rabbit ventricular cardiomyocytes, CFP and YFP fluorescence intensities of the subcellularly targeted CUTies were monitored upon exposure to isoproterenol ± PKD inhibition. These experiments will delineate the role of PKD in modulating the ß-adrenergic signaling pathway and its implications on cardiac function.

Whole Genome Sequencing Identifies Missense Mutation in GRM6 as the Putative Cause of Congenital Stationary Night Blindness in a Tennessee Walking Horse

Yael Hack
Sponsor: Rebecca Bellone, Ph.D.
University Extension

Congenital stationary night blindness (CSNB) is an inherited, non-progressive retinal disorder characterized by absence of vision under low-light conditions. Currently, the only known genetic cause of CSNB in horses is an insertion in TRPM1. However, one Tennessee Walking Horse diagnosed with CSNB did not have this mutation. To identify a causal variant, whole genome sequence data from this case was compared to data from horses from seven other breeds (n=29). One hundred candidate genes were assessed for coding variants. Variants homozygous in the case and absent in all other horses were prioritized for further investigation. A single missense mutation in metabotropic glutamate receptor 6 (GRM6 c.533C>T p.Thr178Met), a gene known to cause CSNB in humans, was identified. This SNP was predicted to be deleterious by the consensus classifier PredictSNP. Thr178 is conserved across vertebrate species and is directly involved in binding glutamate, and is thus essential to on-bipolar cell signaling that enables vision in low light conditions. Methionine at position 178 is hypothesized to impair glutamate binding, which was supported by protein modeling. In screening 90 unrelated Tennessee Walking Horses, the estimated allele frequency was 10%. These data provide evidence that this SNP is causal for CSNB in this breed.

Analysis of the Role of Antibody Surface Density in Neutrophil Phagocytosis

Kay Hadrick
Sponsor: Volkmar Heinrich, Ph.D.
Biomedical Engineering

Neutrophils, the most abundant type of white blood cell in humans, are responsible for engulfing and neutralizing pathogens through phagocytosis. Neutrophils commonly identify pathogens through antibodies such as IgG which are produced by the immune system and bind specifically to pathogenic surfaces. Here, we performed experiments to assess how the surface density of IgG affects the probability and efficiency of phagocytosis. We created artificial pathogens by coating 5-micron polystyrene beads with bovine serum albumin (BSA) and then incubating them in solutions with varying ratios of anti-BSA rabbit IgG to mouse IgG1. These beads presented different effective concentrations of human-reactive IgG because human neutrophils hardly recognize mouse IgG1. We quantified the density of rabbit IgG by using a fluorescent secondary antibody and comparing the fluorescence to standards. We tested for phagocytosis in bulk by mixing neutrophils with these beads for 1 hour. Using flow cytometry, we were able to quantify both the recognition index (average number of beads per cell) and phagocytic efficiency (percentage of cells that engulfed or attached to beads). We found that the probability and efficiency of phagocytosis are correlated with the surface concentration of IgG, and that a threshold density of IgG appears to trigger phagocytosis.

Modeling 15q Duplication Syndrome Using a *Ube3a* Transgenic Mouse

Sophia Hakam
Sponsor: Janine Lasalle, Ph.D.
MED: Medical Microbiology & Imm

Mutations in the ubiquitin protein ligase E3A (UBE3A) gene and UBE3A copy number variations underlie the human neurodevelopmental disorders Prader-Willi, Angelman and Dup15q syndromes respectively. Duplication of chromosomal 15q (including UBE3A) causes Dup15q syndrome, a recurrent genetic cause of autism spectrum disorders. UBE3A protein encoded by UBE3A targets proteins for degradation by the attachment of ubiquitin. UBE3A localizes to the nucleus and cytoplasm of neurons and regulates proteins involved in a wide variety of pathways. The specifics of UBE3A activity is variable depending on the stage of development and RNA splicing of the UBE3A exons. In order to model Dup15q syndrome the LaSalle lab developed a mouse model with an extra copy of Ube3a inserted into its genome. My project is to validate this Dup15q mouse model. To identify mice with the Ube3a transgene genotyping was performed. To confirm that the Dup15q model mice over-express Ube3a, quantitative reverse-transcription polymerase chain reaction (qRT-PCR) analysis and western blot will be performed on neuronal tissues and liver samples after screening for neurologic defects. Dup15q mice represent a novel tool for determining the mechanisms that contribute to autism and related disorders.

Behind the Veil

Noor Halabi
Sponsor: Suad Joseph, Ph.D.
Anthropology

For this project related to our research internship in the Lab of Dr. Suad Joseph on "The New York Times Media Project," we address how the term "veil" is portrayed in the New York Times between 1952 and 1962, the years of Algerian war for independence. We paired the term "veil" with "Algeria" to focus our search on the specific region. Our sample articles, searched through the Pro-Quest platform used in Dr. Joseph's lab, employ the research methodology conducted in Joseph Lab Media Project--media content analysis. Based on documented stories of unveiling ceremonies in Algeria, we argue that the New York Times represented the veil as an oppressive symbol. The "veil" is a symbol which may help us understand the predispositions New York Times authors hold and have encouraged their readers. This research is important to aid in understanding the continuous modern-day politics and debates over the Arab region.

Attraction-Selection-Attrition in the Legal Field: Asian Americans and Public Service Motivation

Aryssa Ham
Sponsor: David Mccourt, Ph.D.
Sociology

What drives people to set aside their personal interests to help the collective? To contribute to the public service motivation literature, I offer a case study on Asian Americans within the legal field. Though prior studies note a weaker interest in the public sector among Asian Americans compared to all racial minorities post-law school, few delve into potential explanations or examine variances among ethnicity. Drawing from both national law student survey data and semi-structured interviews with lawyers and judges, I explore the professional trajectories of Asian Americans—particularly the factors that determine whether and when an individual enters, stays, or switches into the public or private sector. The survey findings illustrate the tangible consequences of the Model Minority construct, and how it manifests in overlooked outcome disparities within the Asian American community. Furthermore, preliminary interview data reveal the influences of immigrant generation, identity saliency, and attitudes toward the public sector on the individual's degree of community and pro bono involvement. Through juxtaposing survey data against the unique narratives gleaned from interviews, I shed light on how agency and structure interact to affect personal career decisions, ultimately extending to how people organize themselves within society.

Development of Low-Cost and Reliable Reaction Wheel for CubeSat Attitude Control

Rafic Hamade
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Manufactured Reaction Wheel (MRW) component of the REALOP mission, UC Davis's first and completely undergraduate-led CubeSat mission. Reaction wheels are required by REALOP to point the satellite's visual and infrared spectrum cameras toward Earth and stabilize them to avoid motion-blur. The REALOP mission is developing low-cost and reliable reaction wheels for CubeSat application. These components are manufactured through the use of the student machine shop on campus, ensuring the cost-effectiveness and documentation of the manufacturing process. To mitigate risk of failure, reaction wheel prototypes will undergo extensive testing to verify that the design withstands launch loads and operates in the vacuum and temperature ranges of low Earth orbit for extended periods of time. Costs of commercial CubeSat reaction wheels typically exceed total budgets for university missions; successful demonstration and detailed documentation of REALOP's reaction wheel will provide university missions with a low-cost and reliable design, lowering barriers to entry to space and improving mission success.

Analyzing the Outcomes of Computer Supported Grading Versus Traditional Paper-Based Grading

Katherine Hamera
Sponsor: Julia Chamberlain, Ph.D.
Chemistry

Computer supported grading has become more popular with chemistry instructors as it streamlines the grading process, the returning of exams to students, and regrade requests. The online grading platform Gradescope allows computer-assisted analyzing of hand-written answers using artificial intelligence for multiple choice and short-answer questions, leaving more complicated grading tasks to a human. Computer grading can support instructors' focus on evaluating open response calculations, drawings, and questions that require greater analysis and application of course content. However, widespread adoption of computer-based grading platforms raises important questions regarding accuracy and consistency of the work graded by humans, and whether the outcomes of computer grading are equivalent to paper- graded work. For this study, we compared grading outcomes for a chemistry exam question graded by teaching assistants (TAs) on paper and with Gradescope. We analyzed inconsistencies between the two media and the frequency of grading errors. Our findings provide insight into the differences between computer-based grading and the former standard of paper-based grading for open response questions, expanding our understanding of the strengths and limitations of each medium.

Activity Budget and Olfactory Enrichment for Two-toed Sloth *Choloepus didactylus*

Logan Hamilton
Sponsor: Dirk Van Vuren, Ph.D.
Wildlife & Fisheries Biology

Enrichment is a central aspect of modern zoo philosophy, with animal care teams employing devices such as toys, novel foods, and forage piles to stimulate intellectual processes and encourage natural animal behaviors. I analyzed the effectiveness of an olfactory enrichment on a single two-toed sloth Choloepus didactylus at the Sacramento Zoo, comparing activity budgets between a baseline "control" period and an enrichment-applied "experimental" period. There was an observed increase in the time spent resting along with decreases in time spent eating and time spent engaging with enrichment items. There was also an observable decline in time spent in the exhibit portion furthest from the indoor den space coupled with increases in time spent closer to and within the den. These results suggest that olfactory enrichment is not an effective long-term solution for encouraging greater sloth activity in a zoo setting. However, it may have a role in infrequent, short-term enrichment programs, and further studies should assess this potential over larger samples.

Lactate Modulation of Dendritic Cells and Macrophages Towards Immunosuppressive Phenotypes

Hyunsoo Han
Sponsor: Jamal Lewis, Ph.D.
Biomedical Engineering

It is well understood that malignant cells prefer to undergo aerobic glycolysis, instead of oxidative phosphorylation. Widely known as the "Warburg Effect," this phenomenon results in the production of lactate. It has become apparent that within the highly concentrated lactate microenvironment of tumors that infiltrating immune cells are not as effective at mounting an immunogenic response against cancerous cells. Typically, innate immune cells (e.g. dendritic cells [DCs] and macrophages [M?s]), upon encountering a 'foreign' antigen and danger-associated signals, are stimulated to act as antigen presenting cells [APCs]. These specialized cells present antigen to CD4+ T-Cells, resulting in T-Cell selection and proliferation, ultimately ending in a honed attack against the target antigen. We seek to further understand the innate immune cell response to lactate concentrated microenvironment using in vitro assays. Our initial results indicate that when DCs and M?s are exposed to lactate, there is a decrease in IL-12 cytokine secretion, even when stimulated with lipopolysaccharide [LPS], which correlates to decreasing immunogenicity. These results on DC and M? phenotypes unveils more about APC function in the context of tumors and provides information for new opportunities to target malignancy.

Investigating the Microbiome Structure in the Valley Carpenter Bee, *Xylocopa varipuncta*

Madeline Handy
Sponsor: Rachel Vannette, Ph.D.
Entomology/Nematology

The gut microbiota of bees has been shown to play a role in keeping the insect healthy and increases host fitness, making microbiome studies increasingly important as bee population levels continue to decline. While both social and solitary bees have been found to maintain a core microbiome, in social bees the microbiome is tightly regulated via social interactions, whereas solitary bees are found to have a more variable microbiome reflective of their environment. However, the microbiome for semi-social bees has been understudied. Given the changes sociality has on the microbiome, I analyzed the microbiome of the semi-social valley carpenter bee, Xylocopa varipuncta, to compare its microbiome composition and structure to social and solitary bees. I hypothesized that X. varipuncta would have core microbiota in the gut that are similar across all colonies, and because of their semi-social behavior, each colony would have a different microbial signature reflective of their foraging and social behavior. Preliminary results show that X. varipuncta is dominated by the genus Lactobacillus, suggesting Xylocopa microbiomes more closely resemble those of solitary bees.

Studying Those Who Study Minds: The Psychology Discourse Community

Abdallah Hashem
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

According to linguist John Swales, discourse communities are groups of individuals sharing common interests, goals, and hobbies who use communication as a means to achieve specific purposes. There are six requirements to form a discourse community: a broadly agreed set of common goals, mechanisms of intercommunication among members, use of participatory mechanisms to provide information and feedback, one or more genres in a communicative aim, and a specific lexis used within the community. This research aims to study the methods of communication within the psychology discourse community. The research methods include personal interviews with students and professionals in the field. The research sheds light on different unexpected ways and purposes of communication within members of the community. For instance, Twitter is a medium where all psychology students and professionals share information and communicates with community members. The research also focuses on how psychology community members use communication to take a leading role in law making efforts with politicians. The research reveals unexpected ways members of the psychology discourse community communicates.

An Effort Towards the Synthesis of Bisavenanthramide B-1

Nicolas Havenner
Sponsor: Jared Shaw, Ph.D.
Chemistry

The synthesis of natural products is a time-honored method of testing the synthetic viability of newly developed synthetic methods. A method recently developed by our group was found to be applicable to the synthesis of Bisavenanthramide B-1, a phytoalexin found in oats. Bisavenanvthramide B-1 is suspected to have analgesic and anti-irritant activity as a component of cosmetics, and its diketopyrrolepyrrole core is easily accessed through use of this new method. Several attempts towards the synthesis are described. Since direct routes to the natural product were known to be unviable, attempts were made to synthesize and carboxylate the decarboxylated compound, both through C-H activation and bromination followed by a lithium halogen exchange and addition of CO2. When this failed, the next method attempted was the synthesis of a deprotectable core, deprotection, and coupling with the carboxylated moeity through a metal-catalyzed cross-coupling reaction. Several substrates were investigated for use in this method but all were found to be unviable. This work describes the attempts undertaken supported by the Provost's Undergraudate Fellowship over the course of a year and a half.

Sustainable Real Vegan Cheese Production by Recombinant Casein Expression With *Kluyveromyces Lactis* to Address Global Dairy Industry Environmental Impact

Eilis Hegarty
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Raw milk production and cattle farm waste are responsible for the majority of the dairy industry's negative environmental impact and high CO_2 emissions. In an effort to reduce the impacts of the global industry, the Real Vegan Cheese (RVC) Project is researching the production of vegan cheese nearly identical to traditional cheese in an environmentally sustainable and economically viable way. Our research focuses on genetically altering the yeast organism Kluyveromyces lactis to express four common bovine casein proteins - Alpha-S1, Alpha-S2, Beta, and Kappa. These proteins are the major proteins found in milk that precipitate into cheese curds when treated with the enzyme chymosin. To date, we have successfully constructed four vector plasmids, each containing genes encoding one of the four casein proteins of interest. We report our current efforts and early results to transform and express these genes in our yeast expression strain K. lactis. The Real Vegan Cheese Project is part of BioInnovation Group, which is one of the first undergraduate-run research organizations at UC Davis providing undergraduate students with collaborative and innovative research experience.

Unraveling the Genetic Controls on Strawberry Shelf Life

Nancy Her
Sponsor: Barbara Blanco-Ulate, Ph.D.
Plant Sciences

From consumers to the food industry, food waste is a serious issue that diminishes resources and causes economic losses. Strawberries are notorious for their short shelf life and readily decays after harvest and can create food waste before or after reaching the consumer. Due to the lack of understanding of the genetics that control fruit shelf life, this project aims to investigate the genetics of strawberry shelf life. My project involved working with five diverse strawberry families and measuring fruit quality at four distinct timepoints during postharvest storage. I analyzed fruit juice for anthocyanin concentrations as an indirect measurement of color. Furthermore, I determined the sugar and acid content through Brix measurements and acid titrations as an indicator of taste. All traits were observed to have large ranges: Brix (4.56%-26.66%), Acidity (0.45%-2.16%), and Anthocyanins (5.46ug/ml-165ug/ml). Significant differences were found between families and postharvest timepoints, which reveals that fruit quality under post harvest conditions has considerable environmental and genetic control. These findings will be integrated with data on a marketability score, other fruit quality attributes, and genetic information to estimate heritabilities and determine genetic correlation between shelf life fruit quality.

Comparison of Asynchronous Telepsychiatry Alongside Synchronous Telepsychiatry in Skilled Nursing Facilities

Mario Hernandez
Sponsor: Glen Xiong, M.D.
MED: Psychiatry & Behav Sci

Access to psychiatric consultations is a critical problem in Skilled Nursing Facilities (SNFs) who have patients who have end-of-life and chronic care needs. Despite the availability of Synchronous Telepsychiatry (STP), which are consultations done through a videoconferencing, it is underutilized due to administrative barriers. This study observes patients consulted through Asynchronous Telepsychiatry (ATP) which utilizes recorded video that is available for the psychiatrist to review, which allows for a more timely and flexible delivery of consultations. ATP is patient-centered, because facility staff and family members participate actively in the interviewing processes. In our on-going, large scale comparative study of ATP and STP patients, we are collecting data from 250 patients at 6 different time points. In this poster, we reviewed 60 patients who have completed all 6 time points and found both ATP and STP lead to reductions of inappropriate antipsychotic medication usage and therefore improved patient safety. Like our 2015 pilot study, our hypothesis is that ATP is as clinically effective as STP but is more accessible, administratively simple and cost-effective. By addressing psychiatric symptoms that would otherwise be untreated until emergency or inpatient treatment is needed, ATP may improve health care quality and SNF residents' quality-of-life.

Wnt/Planar Cell Polarity Transmembrane Scaffold Vangl Promotes Breast Cancer Cell Migration

Maria Hernandez
Sponsor: Colleen Sweeney, Ph.D.
MED: Biochem & Molecular Med

The American Cancer Society estimates that in 2020 276,480 new cases of invasive breast cancer will be diagnosed in the United States. Despite improvements in therapies, nearly 40% of breast cancer patients will relapse with metastatic disease, a significant contributor to cancer-related deaths. Although the molecular mechanisms associated with metastasis are not completely understood, cell migration is commonly accepted to be critical to tumor invasion and metastasis. Wnt/planar cell polarity (Wnt/PCP) signaling, a branch of non-canonical Wnt signaling, mediates migratory events during development. We and others have previously reported that Wnt/PCP pathway component Vangl is frequently dysregulated in breast tumors and Vangl overexpression is associated with poorer prognosis in breast cancer patients. However, the mechanism underlying Vangl contribution to breast cancer malignancy remains unclear. This study investigates the contribution of Wnt/PCP signaling component Vangl to breast carcinoma through the utilization of molecular and biochemical in vitroapproaches. We demonstrate that Vangl drives breast cancer cell migration, modulates Wnt/PCP pathway activity, and may spatiotemporally regulate actin cytoskeletal regulators in migrating cells. Our findings demonstrate that Vangl is a significant contributor to breast cancer cell migration, suggesting that this pathway and Vangl may represent a novel target for interfering with metastatic dissemination.

Museum Design to Preserve Local Culture: Gurase Bhume Aama Samuha Sangrahalaya

Ariana Hernandez
Sponsor: Nancy Erbstein, Ph.D.
Education

In our presentation, we will discuss our research conducted in the village of Maccahpuchhre, Nepal with the Ghurase Bhume Aama Samuha. We were tasked with creating a mural for a local museum to depict the local Gurung culture of the village and enhance the aesthetics of the museum through the general organization of the space. The village's mothers' group, Gurase Bhume Aama Samuha, has a donation-funded building set aside for the museum. The museum is a tool for the Mother's group to preserve their local traditions as educational and rural modernization creates a disconnect from youth in the village to their local traditions. We planned to achieve our objectives by conducting interviews with museum professionals, researching social and cultural contexts of Nepal that will influence the museum, conducting interviews of members of the Machhapuchhre Village, and working with and for the Aama Samuha. We shared our work with the community by collaborating throughout the ten day process. We asked the Aamas to share their traditions and stories through their artifacts which we then depicted in the three murals and the accompanying shelves.

Assessing the Impact of Defense Cooperation on *Terrorism* in Latin American

Colin Heurlin
Sponsor: Brandon Kinne, Ph.D.
Political Science

As the US' War on Terror begins to enter its third decade, we are seeing a resurgence of Latin American terrorist activity from both domestic and transnational terrorist groups. Prior to 9/11, Latin America was the region with the highest volume of terrorist attacks and the highest levels of violence during the 20th century. Despite the US continuously inking more defense cooperation agreements with Latin American governments, there is no empirical evidence that these efforts are robustly affecting levels of terrorism. Because the US is interested in reducing the capacities of terrorists throughout Latin America, it is essential that national security policymakers know the consequences of defense cooperation on terrorism. The intrinsic value of studying the ramifications of defense cooperation on terrorism comes from understanding how the inking of these agreements emboldens combatants to commit terror attacks. This paper serves to analyze whether the presence of defense cooperation affects levels of terrorism in Latin American countries to better inform US policymakers for stronger counterterrorism policymaking.

An Investigation of Adaptive Introgression in *Anopheles* Mosquitoes in Cameroon

James Hibbert
Sponsor: Yoosook Lee, Ph.D.
VM: Pathology, Micro, & Immun

Malaria is one of the most serious diseases in the world, affecting millions living in tropical regions. Studies demonstrated that two major malaria vectors in Africa, Anopheles gambiae and Anopheles coluzzii, hybridized in countries like Benin, Ghana, and Mali. This resulted in the transfer of a portion of the An. gambiae genome containing insecticide- resistance alleles into the genome of An. coluzzii. This is an example of adaptive introgression, when an advantageous gene is transferred from one species to another. In Mali, the timing of hybridization coincided with mass-scale distribution of insecticide treated nets (ITNs). With increasing exposure to insecticide, hybrid genotypes containing insecticide resistant allele can be favored for survival. In this study, we wish to understand if adaptive introgression occurred independently in Cameroon. We will utilize archived mosquito collections with multiple yearly collections from a single village spanning a period of time both pre- and post- ITN use. A multi-plex SNP genotyping assay will be used to obtain genotypes of single nucleotide polymorphisms that distinguish the species and insecticide-resistant mutations. Ultimately, we would like to understand if this adaptive introgression event occurred once and then spread via mosquito dispersal or if it arose multiple times independently.

Development of Bioluminescent Probes for Imaging Bioavailable Metal Ions

Adam Hillaire
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

Metals play critical roles in biology with functions spanning catalysis, signal transduction, and structural support among many others. Because metals are obtained primarily from our diet, their tight regulation is crucial to maintaining homeostasis in biological systems. In fact, metal dysregulation has been linked to various diseases ranging from diabetes to cancer to cardiovascular disease. Understanding metal dynamics in vivo remains challenging due to a lack of tools to characterize their localization, concentrations, and binding environments. To expand the library of tools available to study biological metals, we are developing molecular imaging probes capable of selectively detecting metals in vivo. We are employing the imaging modality known as bioluminescence, the photophysical product of an enzyme-substrate interaction between luciferases and luciferins. Herein we synthesize and characterize a copper(II)-responsive chemical mask tethered to coelenterazine 400a, an analog of coelenterazine, to specifically image Cu(II) in complex biological environments. Upon reaction with Cu(II), coelenterazine 400a is liberated and interacts with its respective luciferase, nanoluciferase, for subsequent oxidation and light production. Future work will focus on applying this probe to understand Cu(II) dynamics in cancer biology.

Iterative Design and Analysis of Standardized CubeSat Structure

Christopher Hipolito
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

REALOP is the first UC Davis undergraduate-based CubeSat team with a launch scheduled for Spring 2021. The structures team is responsible for the design and analysis of the CubeSat frame as well as the integration of control hardware and payload. The goal is to create a structural frame independent of payload, that also provides simple integration of and accessibility to the payload, which uses standardized hardware mounting brackets for ease of mission repeatability. The mounting brackets hold different payload components and control actuators. In order to integrate the electrical PCBs and flight computers safely, a slotted housing unit, referred to as the Stackhouse, will be used to electrically isolate the PCBs from the aluminum frame. To simulate the environment that the CubeSat will experience throughout its lifecycle, research regarding the structure's ability to survive the launch environment and maintain the functional integrity of the CubeSat components will be conducted through analysis of mechanical, thermal, and vibrational loads. A standardized, independent CubeSat structure will allow for simple integration of hardware and scientific payloads for future CubeSat missions.

Insights into Neolithic and Bronze Age Shell Bead Production in Thailand from Stable Carbon and Oxygen Isotopes

Tiffany Hirokawa
Sponsor: Jelmer Eerkens, Ph.D.
Anthropology

Shell beads are a common component of burial assemblages in Neolithic and Bronze Age graves in Thailand. However, little is known about the production of these items, for example, if they were typically produced locally or imported from far-away production centers. This poster explores bead morphometric, as well as carbon and oxygen stable isotopes, of a sample of shell beads from the site Ban Non Wat in central Thailand. Shells growing under different environmental conditions will display different underlying isotopic composition, hence, C and O isotopes can provide insight into where the shells were gathered. Isotope data show that the vast majority of shells used to produce beads come from freshwater locations, with only one bead showing a more marine signature. While Neolithic beads have a signature closer to modern shells collected near the site, Bronze Age beads seem to have more exotic isotopic signatures. Further, there seem to be isotopic differences between large and small beads, suggesting different production centers. Together, we suggest changes from the Neolithic to the Bronze Age in bead production and source.

Utilizing Machine Learning to Analyze Chicago Crime

Johannan Hjersman
Sponsor: Luis Rademacher, Ph.D.
Mathematics

The overall crime rate in Chicago is 62% higher than the national average with 11.47 crimes per 100,000 people occurring daily. Each crime has a wealth of data that is recorded daily into an extensive and evolving public database. Using the Chicago Crime Dataset, we apply machine learning techniques to analyze the data and derive predictions to determine the likelihood of future crimes. We use variables such as date, type of theft, a section of Chicago, weather, and other observed parameters in addition to latent variables to estimate the chance of a crime at a queried time and location. We reference and use standard procedures in machine learning such as k-means clustering and Gaussian mixture models to analyze the data and compare the results with other methods. With the amount of data increasing at a compelling rate, we hope to assist the city of Chicago by providing a helpful analysis and system to interpret the data and reduce future crimes.

Helping Infants Learn Language: Do Parents Exaggerate Speech Sounds When Talking to Infants?

Natalie Ho
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

Caregivers often alter their speech when speaking to infants, using a speaking style known as infant-directed speech (IDS). The current study explores this phenomenon by investigating whether parents hyperarticulate, or exaggerate speech sounds, to make their speech more clear when talking to infants. Specifically, we are investigating how parents vary their production of "t" sounds in speech towards infants versus adults. We are coding emphasized and reduced "t" sounds (e.g. 'cheetah' pronounced with a clear "t" versus a "d" sound; 'cat' produced with a clear versus dropped "t"). Parents engage in two sessions of interactive tasks—first with their infant (11-month-olds and 19-month-olds), then with an experimenter. Parents are asked to incorporate a set of consistent target words to encourage the use of words with "t" sounds across both speaking registers. Sessions are audio and video recorded and analyzed for the "t" articulation as well as the positioning of the target words in sentences. Our preliminary data includes 10 participants, but coding is ongoing. We predict that parents try to present helpful language learning tools to their infants. Therefore, they will produce more clear speech to their infants than to adults, showing more hyperarticulation in IDS.

Can Persuasive Memes Get People to Exercise? Stereotype Threat and Lift Effects on Physical Activity

Troy Hoang
Sponsor: Jorge Pena, Ph.D.
Communication

This study tested how raising the salience of stereotypes about men and women's physical prowess through memes can influence physical activity. Participants were randomly assigned to one of three meme exposure conditions (stereotype threat, stereotype lift, control) and then asked to perform a running task for ten minutes while onscreen motion-capturing avatars displayed the participant's face. Physical activity was measured with accelerometers and a heart rate monitor. Based on stereotype threat effects, we expect that exposing participants to a meme that threatens confidence in their physical abilities may decrease their cardiac frequency and step count relative to the remaining conditions. These effects may be linked to the concept of "stereotype lift" and "stereotype threat" in the context of exercise-related video games (Li & Lwin, 2015). The data was collected in fall 2019 and preliminary results will be discussed. The findings may illuminate how new technologies may be harnessed to incentivize health-related outcomes.

Determining the Width of the Space Charge Region in Strontium Titanate Particle Films Using Surface Photovoltage Spectroscopy

Brett Hodges
Sponsor: Frank Osterloh, Ph.D.
Chemistry

The ability of semiconductors, such as $SrTiO_3$, to serve as nanoparticulate catalysts for water-splitting depends on electronic band structures at semiconductor interfaces. Electric fields established at these interfaces due to band bending reduce the concentration of majority charge carriers within a region of the semiconductor. The width of this depleted region, termed the space charge region (SCR), is currently calculated using a model produced from studies on bulk semiconductors. However, this model has yet to be applied to systems of semiconductor nanoparticle films. For the first time, we employ surface photovoltage spectroscopy (SPS) to explicitly probe the dimension of the SCR in nanoparticle films of $SrTiO_3$. $SrTiO_3$ films were prepared using a drop-coating method and annealed at various temperatures prior to profilometry, UV-Vis spectroscopy, and SPS measurements. Observed SCR widths were determined to be orders of magnitude larger than those predicted using the existing model, indicating its inaccuracy in describing nanoscale systems.

Probing Chromosome Entanglements During Meiosis

Mari Hoffman
Sponsor: Sean Burgess, Ph.D.
Molecular & Cellular Bio

Meiosis is an important biological process that reduces ploidy to form haploid gametes. During meiosis in Saccharomyces cerevisiae (budding yeast), homologous chromosomes pair, synapse, and recombine in a dynamic environment. For meiosis to be successful, chromosomes are organized in two ways. One level of organization is the attachment of the ends of the chromosomes to the nuclear envelope through a protein called Ndj1. A second way chromosomes are organized in meiosis is through Nup2, a nucleoporin that attaches interstitial regions of the chromosome to the nuclear pore complex. Our lab found that when these two key proteins are absent, the chromosomes fail to separate at meiosis I. My hypothesis is that the chromosomes are unable to come apart due to entanglements between them. I will test my hypothesis using pulsed-field gel electrophoresis, a technique that can resolve full length chromosomes, to see if the chromosomes of the double mutant are unable to separate.

Design of a Liquid Argon Purity Monitor

Christopher Hopp
Sponsor: Emilija Pantic, Ph.D.
Physics

There are currently a number of experiments searching for direct detection of the Weakly Interacting Massive Particle, a potential dark matter candidate. The DarkSide-20k experiment at Gran Sasso National Laboratory in Italy uses a dual-phase argon time projection chamber to search for collisions between WIMPs and argon nuclei. These collisions would be characterized by a signature of emitted photons and freed electrons. Maintaining high liquid argon purity levels is critical to the function of the detector as impurities can trap electrons in the drift region. Following is a design for a purity monitor to be implemented in a mock-up for the DarkSide-20k dark matter experiment. The monitor utilizes a photocathode and UV xenon lamp to liberate electrons in a uniform electric drift field. The fraction of electrons received at the anode serves as a relative measurement of argon purity as electrons liberated at the cathode are captured by impurity in the drift region. We expect to achieve a sensitivity to electron lifetimes on the order of milliseconds.

Heat Knock Down Assay Assessing the Fitness Effect of a Color Polymorphism in *Drosophila serrata*

Majken Horton
Sponsor: Artyom Kopp, Ph.D.
Evolution & Ecology

There is a sex-limited color polymorphism in Drosophila serrata, where females appear in light and dark morphs, while the male fly always has the light phenotype. This color polymorphism is controlled by a single locus where the dark allele is dominant and light is recessive. This study was to assess the difference of fitness in homozygous dark and light D.serrata flies. Due to a clinal variation in the female color frequency in Australia where these flies are found, we decided to measure a proxy of fitness via a heat knock down assay. We predicted that the heat stress test would show light flies to have a greater heat tolerance, because lighter pigmentation may reflect light and heat more efficiently, thus providing protection in the northern, hotter climate. Comparing male to female knock down times was not significant. When comparing light to dark, knock down times were statistically significant. Dark genotype females and males had a higher average of heat knockdown times, lasting 175.80 seconds longer than light flies. This finding may signify the alleles themselves may be involved with other physiological traits.

Ibuprofen Treatment Affects Cathepsin L Activity in Mice in a Sex-Specific Manner

Tiange Hou
Sponsor: Aldrin Gomes, Ph.D.
MED: Physiology & Membrane Biol

Ibuprofen, an NSAID, is commonly used to relieve pain and fever. Previous research done in our lab found that ibuprofen has the potential to impair proteasome activities. Deficits in proteases such as proteasomes are linked to many diseases such as Alzheimer's disease and cardiovascular diseases. Unlike the proteasome, which degrades most intracellular proteins via the ubiquitin-proteasome system, lysosomes play a critical role in degrading whole organelles and most extracellular proteins via the lysosome-endosome pathway. Cathepsin L and cathepsin B are two proteases in the lysosome. Both male and female skeletal muscles, from control mice and ibuprofen-treated mice, were prepared and tested for cathepsin L and cathepsin B activities. There is a significantly decreased cathepsin L activity in ibuprofen-treated skeletal muscle from male mice compared to the control mice. There is no statistically significant difference for cathepsin L activities found in female mice. We also found no statistically significant difference for cathepsin B activities in both male and female mice. As such, the results suggest that ibuprofen may have a sex-specific influence on lysosomal activities.

Using CRISPR Interference to Understand the Roles of Novel *Giardia* Kinesins

Julia Huang
Sponsor: Scott Dawson, Ph.D.
Microbiology & Molec Genetics

Giardia, a unicellular protist, causes diarrhea with a global incidence of 100 million cases annually. With eight flagella and a ventral disc, the microtubule-based cytoskeleton is important for motility and for attachment to the epithelium of the host intestine. The assembly and functionality of these microtubule-based structures are regulated in part by a family of microtubule motor proteins called kinesins. Giardia has 24 kinesins representing all conserved kinesin families. Previous studies have shown that Kinesin-13 and Kinesin-2 influence the length of Giardia's flagella. To determine the cellular roles of other representative Giardia kinesins, we used CRISPR interference (CRISPRi) to repress kinesin transcription. For each kinesin, we designed and tested several guide RNAs and created stable CRISPRi knockdown strains. Fluorescence microscopy was performed to screen for cytoskeletal defects. Mutants were analyzed for aberrations in morphological and physiological properties such as disc structure, beat waveform, attachment, and flagellar length, and phenotypic penetrance was scored for each knockdown strain. Knockdown of GL50803_14070, a member of a novel kinesin family, resulted in defects in disc structure, flagellar function, and cytokinesis. This implies that novel Giardia kinesins have evolved conserved cytoskeletal functions.

Using Body-Ownership Illusions to Reduce Pediatric Needle Pain

Midori Huapaya-Renbarger
Sponsor: Jonathon Schofield, Ph.D.
Mechanical & Aerospace Engr

Many standard pediatric medical procedures involve needle sticks. For children, the resulting needle-pain can be traumatic and often results in a fear of needles. In fact, around 20-50% of adolescents and 16% of adults remain scared of needles, and this fear is a well known contributor to medical avoidance behaviors. Our team has created a game-device that induces a body-ownership illusion called the rubber hand illusion. This illusion alters the patient's sense of limb 'ownership' and increases the pain threshold of the treated limb. My role was to design and fabricate a device that induces this same illusion by delivering vibration feedback to a patient's treated limb when they press colored buttons on a 3D-printed false hand. By using this system, patients self-induce the rubber hand illusion. Therefore, when a patient uses this system during a needle stick procedure, the pain they experience should be significantly less than the pain they would typically experience. This system will be used in future trials in clinical environments. If successful, needle-pain management is a significant innovation that is applicable to both increasing pediatric patient comfort and reducing cases of avoidance to medical procedures.

Variation in Ground Fish Species Responses to Marine Protected Areas

Haley Hudson
Sponsor: Steven Morgan, Ph.D.
Environmental Science & Policy

The California Collaborative Fisheries Research Program (CCFRP) is a statewide effort to collect robust fisheries-independent data through catch and release fishing in marine protected areas and reference sites in collaboration with volunteer anglers and commercial fishing vessels. Fishes were randomly sampled in each MPA and comparable reference site containing rocky reef habitat and similar depth range, and fishing time was recorded in each grid cell to measure effort. Standardized fishing methods allowed for comparisons of ground fish populations throughout the state and over time. We report results from two pairs of marine reserves and reference sites that we surveyed since 2017 along the northcentral coast, including mean length, and catch-per-unit-effort (CPUE). We addressed two questions: 1) Does reserve designation impact fish populations? 2) Which species'-specific responses are strongest? After just three years, fish CPUE was generally greater in the Bodega Head and Stewarts Point State Marine Reserves than in paired reference sites, though abundance varied by species, site, and year. When species were separated by ecological guild, water column fish (highly mobile schooling species with shorter lifespans) and bottom fish (longer-lived solitary species), the groups varied in their responses to MPAs.

Modulation of Auditory Capture by the Identity of Pre-existing Visual Stimuli

Jocelyn Huerta
Sponsor: Joy Geng, Ph.D.
Psychology

Previous research has shown that sounds can distract from visual tasks when they occur in a different location from a visual object, but they also facilitate visual search when they are spatially ambiguous or semantically consistent with the visual target object. However, it is not yet known how knowledge of a visual object's attentional priority influences processing of auditory stimuli during visual search. In the present study, we asked subjects to search for a visual target embedded on visual objects (e.g., ducks, frogs). Here, we hypothesized that auditory sounds congruent with the more likely target object (i.e., a "quack" or "ribbit") would facilitate search, despite being completely task-irrelevant. We further predicted that congruent sounds would facilitate saccadic eye movements towards the visual target. Preliminary results are consistent and suggest that multisensory integration of real-world objects is automatic and attentional priority in one modality influences sensory processing of congruent information in another modality.

Taking X-Rays of Students' Knowledge Structures with More Advanced Instruments: An Examination of Chemistry Students' Concept Maps

Emily Huie
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

General chemistry is a fundamental course essential for developing a deeper understanding of topics presented in other science courses. To develop more effective teaching methods, it is imperative to find empirical and pragmatic methods chemistry educators can employ to analyze and evaluate how students learn chemistry. Concept maps are commonly used to provide educators a visual representation of students' level of understanding, help students make connections between topics, and measure changes in their understanding after any intervention. Current qualitative and quantitative methods introduce a level of difficulty in analyzing concept maps and determining an objective depiction of a large group of students' conceptualizations. In this study, concept maps generated by students at the end of the CHE 2 series were analyzed under the light of three factors: chemistry performance, math proficiency, and gender. The main goal of this study was to examine the feasibility of using Fiji Image J, a software commonly used in biology, to generate concept maps representative of large groups of students in any field and provide educators a novel synthesis of the use of R Studio and Gephi in examining students' understanding of chemistry topics in connection with gender, chemistry performance, and math proficiency.

Ozone Exposure During Postnatal Lung Development Decreases Proliferation and Changes Secretion Associate Genes

Daniel Hulme
Sponsor: Laura Van Winkle, Ph.D.
Cntr For Health & Environment

Ozone exposure (OE) early in postnatal life can alter lung growth resulting in significant decreases in rat small airway diameter and length. This study uses real-time polymerase chain reaction (RT-PCR) and immunohistochemistry (IHC) to examine molecular changes in the distal conducting airway. Male and female rats were exposed from postnatal day 7-28. Six rats per sex and treatment group received 0.5ppm ozone or filtered air (FA). Juvenile samples were collected 3-4 days after OE cessation. Adults recovered in FA for 4 weeks before samples were collected. Global gene expression analysis indicated that different treatments induced differences in expression of genes associated with secretions in the lung. We examined Club Cell Secretory protein (CCSP), Proliferating Cell Nuclear Antigen (PCNA), Surfactant Protein-D (SPD), Surfactant Protein-C (SPC), and Surfactant Protein-A1 (SP-A1). Data showed expression of PCNA and CCSP was statistically significantly decreased in the distal airways of female rats. Male rats showed similar decreases; however, they were not statistically significant. This may be due to a longer post-exposure timepoint in this group or the small N. We conclude that early life OE changes expression of secretory cell associated genes and alters cell proliferation.

Product Development of a Color Changing Healthy Alternative Pastry Snack for Kids Using Upcycled Ingredients

Giyeon Hwang
Sponsor: Alyson Mitchell, Ph.D.
Food Science & Technology

In recent years, the awareness of healthy life-style choices and rapid growth in food allergies has increased in children and their millennial parents which impact the food industry. To address this, we developed a convenient, innovative and healthy snack that is safe for food allergic kids, while aiming for sustainability. Chameleon Doodle Pockets are a color changing pastry that can be drawn on, and are known for having high fiber, protein, vitamin C and made with upcycled ingredients while focused on health-conscious millennials who have children. The combination of our gluten free flours offered high vitamin A and calcium while displaying an elegant aroma. The fruit filling made with elderberry, watermelon rind and banana peels contained notable vitamins, phenolic compounds and flavonoids which have pronounced positive effects in vitro. Kids were influenced by the color-changing effects in anthocyanins found in purple sweet potato, that changed from dark purple to bright pink when a low pH transparent gel pen was applied to the pastry. Choose All That Apply (CATA) test results indicated kids enjoyed the fruity, sweet, and chewy characteristics of our product. 9-point hedonic and JAR scale indicated kids preferred our product over Kellogg's pop tart.

Diagnosis Specific Discharge Orders for the Improvement of Healthcare Quality at a Student Run Clinic

Jorge Hurtado
Sponsor: Lorena Marquez, Ph.D.
Chicano Studies

This project was created to improve the quality of healthcare for patients of Clinica Tepati. Clinica Tepati is a student-run clinic that provides primary healthcare to the underserved Hispanic population of the Sacramento area. This project allowed for the development of educational discharge orders for a variety of diagnoses. Furthermore, the discharge orders were created to account for those patients with language disadvantages. The first drafts of the discharge orders were created by medical students from UC Davis School of Medicine and California Northstate University College of Medicine that concurrently volunteer with Clinica Tepati. The first draft was then translated into Spanish by UC Davis undergraduate students that volunteer with Clinica Tepati. The collection of orders was then compiled and analyzed collectively to create a standardized template for discharge orders. Once finalized, the orders were approved by Physicians who volunteer with Clinica Tepati. To assess the efficacy of the orders, they were dispensed along with a short assessment survey. The surveys were then compiled to assess shortcomings of the orders and make adjustments accordingly. With this project, Clinica Tepati has created an extensive collection of discharge orders that will improve the healthcare experiences of the clinic's patients.

Executive Function and Bilingualism: A Study with Young Dual Language Learners in Head Start

Rosamaria Ibarra
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Previous studies on children ages 8-11 years old revealed mixed findings on the associations between executive function (EF) and bilingualism. Few studies have been conducted with younger children and with DLLs from different language backgrounds. This study examines the association between EF and bilingualism in 52 Mexican-American and 95 Chinese-American preschoolers enrolled in Head Start centers in Northern California. EF was measured with the Flanker task on the NIH Toolkit and the Head-Toes-Knees-Shoulders test. Children's bilingual proficiency was measured with the Picture Vocabulary, Oral Comprehension, and Understanding Direction subtests of the Woodcock-Johnson Test. Results show no significant difference between the two groups on bilingual proficiency and on the EF tasks. Cluster analysis with home language and English vocabulary resulted in four groups: children with high proficiency in both languages (HI-HI); children with low proficiency in both (LO-LO), English dominant (ENG) and home-language dominant (HL). Examination of the clusters on EF shows that LO-LO scored significantly higher than ENG on the Flanker task and that HI-HI scored significantly higher than ENG on the Head-Toes-Knees-Shoulders task. Results suggest associations between EF and bilingualism may vary by measure and the type of EF.

Should I Stay or Should I Go: Do Boldness and Docility Levels Predict Risk-Taking in California Ground Squirrels

Marisol Ibarra Zea
Sponsor: Rahel Sollmann, Ph.D.
Wildlife & Fisheries Biology

Animal personality is defined as a cluster of traits that are stable within an individual over time. Two personality traits that may influence how individuals respond to these risks are boldness and docility. Boldness is a likely indicator of an individual's response to risk. Docility is a measure of an individual's propensity to be calm versus erratic. We investigated whether an individual's level of boldness or docility predicted the number of risks it was willing to take. We used an individual's propensity to enter a trap as a measure of risk. Boldness and docility were measured using an emergence test and a handling bag test, two commonly used measures of personality traits in wild populations of rodents. Results demonstrated that docility was not a significant predictor of the number of times an individual was captured in a trap (p-value < 0.22). However, boldness was found to be a significant positive predictor of the number of captures (F = 16.23, and p=value < 0.001). Thus, a squirrel's personality, specifically its boldness, influenced its propensity to take risks. Docility may be a predictor of other aspects of risk, such as the time it takes for an individual to take a risk.

Design of a Kv1.3 Channel Construct for Biotin-based Proximity Labeling of Novel Interacting Partners

Rania Ibrahim
Sponsor: Heike Wulff, Ph.D.
MED: Pharmacology

The voltage-gated Kv1.3 potassium ion channel is important for the proliferation and activation of immune cells, such as T lymphocytes, macrophages and microglia in the brain. Kv1.3 mediates potassium efflux and thus maintains a negative membrane potential crucial for calcium entry, regulating cytoplasmic calcium levels. There are two phenotypes of microglia, the classical activation M1 which initiates the proinflammatory response, and the alternative activation M2 which helps with repair. The expression of Kv1.3 is elevated in M1 microglia, a key driver of neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease. Our project aims to identify novel interacting partners of Kv1.3 using protein biotinylation to label proteins in close proximity of Kv1.3. Biotinylation is the process of attaching biotin to proteins, which are later detected with streptavidin through the tight covalent bonds formed between biotin and the antibody (protein and ligand). By identifying proteins interacting with Kv1.3 channels, we can better understand channel function and expression in diseases. Protein interactions are also useful for binding site optimization for drug development, modulation of drug response, and finding alternative targets to reduce Kv1.3 currents by inhibiting positive trafficking effects by potential Kv1.3-associated proteins.

Functional Evaluation of Human-Specific Duplicated Gene *NPY4R* Using Zebrafish

Cole Ingamells
Sponsor: Megan Dennis, Ph.D.
MED: Biochem & Molecular Med

Human-specific segmental duplications (HSDs) are regions of the genome >1 kbp with over 98% sequence similarity. HSD genes may be an evolutionary source of phenotypic traits unique to the human lineage. One HSD gene, NPY4R, encodes a pancreatic polypeptide receptor which acts as a satiation stimulator. Copy number variation of NPY4R in humans is positively correlated with an increase in BMI and waist circumference. We hypothesize that NPY4R is responsible for developmental growth increases in humans. To test this, we generated a stable "knockout" line of zebrafish using CRISPR/Cas9 carrying a 4-bp deletion on the single NPY4R exon leading to a premature stop codon. Preliminary data of morphometric measurements at 3 and 5 days post-fertilization (dpf) zebrafish homozygous for the knockout allele exhibit a significant increase in body area when compared to wildtype siblings. Moving forward, we plan to inject human paralogs of NPY4R mRNA into wildtype zebrafish and detail morphological changes. If the trend observed in preliminary experiments remains, we will assay for differences in lipid accumulation in our lines using (1) a fluorescent cholesteryl ester analog and (2) a diet treatment (high-fat vs control). If successful, implications of NPY4R on human growth and development may be revealed.

The use of Morphometric Analysis to Evaluate Nutritional Status of Delta Smelt *Hypomesus transpacificus* in the Sacramento and San Joaquin River Delta

Amanda Inouye
Sponsor: Tomofumi Kurobe, Ph.D.
VM: Anat Physio & Cell Biology

Delta Smelt (Hypomesus transpacificus) is an endangered fish species in the Sacramento and San Joaquin River Delta (the Delta). There are a number of possible causes of fish population decline in the Delta, however, we hypothesize that food limitation is one of the primary causes. To assess food availability in the natural habitat of Delta Smelt, researchers at the California Department of Water Resources performed a Delta Smelt caging experiment in which hatchery-reared fish were deployed in three different locations in the Delta in fall 2019 (Suisan Marsh, Rio Vista, and Yolo Bypass). Survivorship and nutritional status of the fish over time were assessed. Fish photos taken pre- and post-deployment in the field and were used for morphometric analyses. Distances among landmarks on fish, including body length, max body depth, body depth at pectoral fin, body depth at pelvic fin, and dorsal-to-caudal fin were measured as metrics of nutritional status. Data from a fish starvation experiment in a laboratory setting were used as a baseline to assess nutritional status in individuals from the caging study. In my presentation, I will talk about my findings from the field and lab experiments and discuss the ecological issues in the Delta.

Cellulose Nanofibril Synthesis and Amphiphilic Superabsorbent Aerogels

Sonia Iqbal
Sponsor: You-lo Hsieh, Ph.D.
Biological & Ag Engineering

Sugar cane is a major food and biofuel feedstock in the world, producing significant under-utilized residues. In this study, cellulose has been isolated from sugar cane bagasse at 39.1% yield. The isolated cellulose samples were characterized in terms of thermal degradation behavior by TGA and qualitatively of surface chemistry using FTIR. Under the optimized TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl) mediated oxidation with 5 mmol/g NaClO per g of cellulose followed by 30 min mechanical blending, highly uniform (1.34 nm thick, up to 1µm long) cellulose nanofibrils (CNFs) were derived at a 98.3% yield and contained 1.32 mmol surface carboxyls per g of cellulose. Upon ice-templating, i.e., freezing (-20 C) and freeze-drying (-50 C, 0.05 mbar) of dilute aqueous TEMPO-CNF suspensions (0.56 w%), CNFs self-assembled into ultra-porous (over 99% porosity, 141.6 mL/g pore volume) and ultra-low density (7.09 mg/cm^3) aerogels. These CNF aerogels were amphiphilic and super-absorbent, capable of absorbing either water (109.6 mL/g) or chloroform (105.0 mL/g). Because of their versatility, these biodegradable CNF aerogels have ample potential applications in a variety of fields.

Professional Development Through Online Modules for Teachers of Language Learners

Caitlyn Ishaq
Sponsor: Margarita Jimenez-Silva, Ed.D.
Education

Under the STEMSS EL CRUISE U.S. Department of Education grant, the Teacher Education and Development Lab put together modules for teachers of all grade levels to use as professional development experiences. These modules work specifically to provide teachers with strategies to better support Language Learners in their education. First, content presentations, which are science and culture based lessons that teachers can adapt for use in their own classrooms, were provided. Next, various strategies to teach this content in a way that better supports Language Learners were presented. After that, opportunities for teachers to connect with each other and communicate the skills they learned through the modules were given. In the pilot phase, teachers of different grade levels implemented the skills presented to them in the modules into their own classrooms. The modules were piloted with current teachers and feedback was used to edit the modules. Feedback data was analyzed to create a guide for future module creation. Themes based on the feedback data includes attention to length of modules and applicability across grade levels. The created guide will be used for the creation of additional modules and will be shared at various national conferences.

Improving Access to Primary Care Resources for Trauma Patients

Anastasiya Ivanko
Sponsor: Joseph Galante, M.D.
MED: Surgery

A traumatic event is often a patient's very first encounter with the medical system. During their admission, trauma patients are often diagnosed with a chronic disease, but do not have access to receive further treatment for a newly identified physical or mental condition(s). Due to the short and potential long term consequences of these newly diagnosed findings, trauma is the leading cause of death in patients younger than 45 years old. After these patients are treated for their traumatic injuries, they are discharged and left to facilitate their own primary care follow ups for any accompanying diagnoses. In addition, long-term insurance coverage must also be established independently, which is often not obtained. Lack of insurance results in a greater difficulty accessing inpatient rehabilitation, skilled nursing care, prescriptions, primary care, and home health opportunities. The goal of this study is to improve access to primary care services for uninsured trauma patients via inpatient counseling with or without referral to a free UC Davis student-run clinic to manage a chronic condition. We hypothesize that referral will increase the rate of follow up, at which patients establish insurance coverage, and decrease 30-day readmissions.

Deep Brain Stimulation for Traumatic Brain Injury

Sandhya Iyer
Sponsor: Gene Gurkoff, Ph.D.
MED: Neurological Surgery

Traumatic brain injury (TBI) is a leading cause of disability, affecting over 1.5 million Americans every year. Our lab previously demonstrated that theta oscillations (6-10Hz) are reduced in a rodent model of TBI. Theta, modulated by the medial septal nucleus (MSN), is critical to cognition. We hypothesized that theta frequency deep brain stimulation (DBS) of the MSN would improve cognition following TBI. Adult male rats (n=33) were randomly assigned into groups: Sham (no-injury), TBI (no-stim), TBI-Acute (stim. post injury day (PID0-3)), TBI-Mid (stim. PID3-7), and TBI-late (stim. PID8-12). MSN stimulation parameters were as follows: 7.7Hz, 80µA, 30min/day for 5 days. Animals were subsequently tested on the Barnes Maze (BM; PID8-11), Novel Object Test (NOR; PID12), and Morris Water Maze (MWM; PID13-17). For all tasks, untreated TBI rats performed worse than sham controls. In the MWM, there was no benefit of stimulation on performance. In the BM, the Acute and Mid groups had improved performance. In NOR, only the Late group showed increased novel exploration. These results demonstrate that stimulation can improve outcome, and the specific time of stimulation following injury is critical for cognitive improvement.

Chiral Organosilicon Compounds as Novel Catalysts and Ligands

Sarai Jaime
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Organosilicon compounds are ubiquitous in many products that enable our modern lifestyles ranging from polymer materials to agrochemicals to personal care products. Previous work in the Franz group has demonstrated that novel silanediol and disiloxanediol organocatalysts possess hydrogen-bonding and anion-recognition properties; however, enantioselective, chiral-at-silicon variants remain elusive. This work describes a new approach for the synthesis of chiral-at-silicon variants from a prochiral silanediol by employing a chiral amino-acid based catalyst, previously reported by Hoveyda and Snapper to selectively react one alcohol group of a meso 1,2-diol. The goal of this project is to synthesize and evaluate analogs of the chiral amide catalyst containing different Lewis basic heterocycles to promote the selective reaction of one OH group of a prochiral silanediol. The reactions of silanediols will be monitored using in-situ IR spectroscopy methods to compare kinetics and chiral HPLC to determine the enantioselectivity of the process. The results of these methods and kinetic studies will provide insight into rarely studied silanediol desymmetrization reactions and guide incorporation of chiral silanols into ligands and organocatalysts.

Mutations in Conserved Hydrophobic Amino Acids of UNC-84 Leads to Nuclear Migration Failure in *C. elegans*

Laura Jameson
Sponsor: Daniel Starr, Ph.D.
Molecular & Cellular Bio

Nuclei move during mitosis and differentiation; defects in nuclear positioning are associated with human diseases like cancer and Emery-Dreifuss Muscular Dystrophy. The LINC complex, consisting of SUN proteins at the inner nuclear membrane and KASH proteins at the outer nuclear membrane control nuclear migration and anchorage. UNC-84 (SUN) and UNC-83 (KASH), interact in the aqueous perinuclear space. Structural studies of mammalian SUN proteins identified two conserved hydrophobic isoleucines on the exterior of UNC-84 near the interaction domain at the outer nuclear membrane with UNC-83. Because hydrophobic amino acids are not typically found on the exterior of proteins, we hypothesized that this hydrophobic patch may be directly interacting with the outer nuclear membrane. I will mutate the -141 and -143 isoleucines to nonpolar glycines and charged lysines by using CRISPR/Cas-9. Observing the nuclei that fail to migrate from the dorsal cord will indicate a defect in the LINC complex. Preliminary data in the lysine mutants suggest that the -141 and -143 isoleucines are necessary for nuclear migration. These results suggest that conserved SUN proteins directly interact with the outer nuclear membrane.

0D Modeling in Radioembolization: An Alternative Method of Predicting Blood Flow Inside the Liver

Nursultan Janibek
Sponsor: Simon Cherry, Ph.D.
Biomedical Engineering

Liver cancer is increasingly treated with radioactive microspheres injected in the hepatic artery in a procedure called radioembolization. Advanced treatment planning for radioembolization is being developed using computational fluid dynamics simulations have been used in order to predict blood flow inside the liver and estimate where the radioactive microspheres will go in the liver. These simulations are computationally expensive. 0D modeling is an alternative method of predicting blood flow inside the liver using electrical components such as resistors, capacitors and inductors. The literature describes various models, but some lack accuracy due to lack of complexity, or have impractical components and/or are too complex, contradicting the purpose of the model. The project combines the best parts of various models in order to achieve fast simulation times as well as high accuracy. This approach is expected to produce a full model of the cardiovascular system, reducing computation cost while being flexible to adjust the model to individual patients.

Factors Sustaining Bilingual Educators

Isabela Jauregui
Sponsor: Maciel Hernandez, Ph.D.
Human Ecology

Bilingual education is critical for reducing the achievement gap between dual language learners and native English speakers. However, the United States has a shortage of bilingual teachers and high teacher turnover rates. Because of the associated benefits of bilingual education for dual language learners and an increasing need for bilingual teachers to meet the needs of dual language learners, we investigated the factors that sustain bilingual teachers to stay in their profession. Through the use of focus groups, bilingual educators (N = 28) were asked about what sustains their teaching practice and keeps them in the teaching profession. Common themes that arose as primary motivators for bilingual teachers to continue being in their profession were the love that they poured into their students as well as the hope they felt that students would succeed in the future. We will discuss how these motivating factors sustain bilingual educators to remain in their profession. This research has implications for helping support current and aspiring bilingual teachers to fill the need of bilingual education in the United States.

Determining the Role of the *Arap1* Gene in Photoreceptor Survival Through Examination of the Mouse Retina

Seanne Javier
Sponsor: Ala Moshiri, M.D.,Ph.D.
MED: Eye Center

Known to cause permanent vision loss, inherited retinal degenerations (IRDs) are a form of childhood and early-adolescent blindness. IRDs are often a result of death or dysfunction of the photoreceptor cells of the retina. Finding treatments that can slow progressive degeneration or reverse its effects requires a better understanding of its underlying mechanisms. This research focuses on Arap1, a gene vital to photoreceptor survival, by using knockout mice lacking the gene to investigate the gene's role within the mammalian retina. Knockout and wild-type mice eyes were checked for ocular irregularities using optical coherence tomography and fundus photography. Immunohistochemistry techniques were used to analyze cell-specific antigens and pinpoint any cellular irregularities between Arap1 -/- and wild-type mice. Preliminary evidence suggests that Arap1 -/- mice undergo photoreceptor degeneration four weeks after birth. Heightened Arap1 presence was also found in Müller glia and the retinal pigmented epithelium (RPE) rather than photoreceptors, which implies a link between photoreceptor health and these nearby cell types. These results provide information that can be used to further explore the cellular processes in which Arap1 participates. Lessons learned from future experiments can also build knowledge on retinal physiology, paving the way for the development of potential therapies for retinal disease.

Optimizing Growth of *Pichia pastoris* and Isolation of Mpr1 to Improve Migration of Therapeutics Across the Blood Brain Barrier

Devi Jayakrishnan
Sponsor: Angela Gelli, Ph.D.
MED: Pharmacology

The metalloprotease Mpr1 of the fungal pathogen Cryptococcus neoformans facilitates the migration of fungal cells across the blood brain barrier (BBB) in order to infect the central nervous system. Since Mpr1 plays such a significant role in helping C. neoformans cross the BBB, I hypothesize that the conjugation of the metalloprotease Mpr1 to various nanocarriers will serve as a platform to promote drug delivery across the BBB. To test this hypothesis, large quantities of Mpr1 must be produced and isolated from the eukaryotic expression system pichia pastoris. To determine optimal growth conditions the standard condition was compared to nine different conditions where one variable was changed in each. The preliminary results indicate that addition of sorbitol during methanol induction increases the final optical density from 9.65 to 31.2. We report a 223% increase in final optical density in this optimized condition. After this point, Mpr1 will be conjugated to nanocarriers and transportation across the brain endothelium will be checked in an in vitro model.

Modeling Familial Pancreatic Cancer with CRISPR-Cas9 to Develop Personalized Cancer Therapy

Keely Ji
Sponsor: Changil Hwang, D.V.M.,Ph.D.
Microbiology & Molec Genetics

Pancreatic cancer is the third leading cause of cancer-related death in the United States. The cause of pancreatic cancer is unclear, but around 10% of pancreatic cancer is hereditary and categorized as familial pancreatic cancer (FPC). To develop a more effective treatment, there is an urgent need for a better model that considers the specific gene mutations found in each patient for personalized therapy. This study aimed to model the gene mutations found in FPC using CRISPR-Cas9 technology. Then, the mutant clones were treated with a panel of drugs to evaluate the efficacy of each drug on reducing the cell viability by measuring with the alamarBlue assay. We modeled a handful of FPC gene mutations in the murine pancreatic cancer cell line (mT3-2D Cas9) and proceeded with the drug treatment for the multiple mutant clones. We observed that the Brca2 or Palb2 inactivation led to an increased sensitivity to Olaparib. In addition to providing a guide for selecting the optimal treatment for an individual, this research opens up the possibility of using patient-specific models to predict the drug response in an individual prior to one's treatment to reduce the unnecessary side-effects from ineffective treatments.

Monte Carlo Simulations of Magnetic Ordering in Square Artificial Spin Ice

Daniel Jiang
Sponsor: Yayoi Takamura, Ph.D.
Materials Science&engineering

Artificial spin ice (ASI) structures consist of arrays of coupled nanomagnets that enable the study of magnetic frustration and thermal relaxation in various geometries. They are useful for studying how array geometry and dipolar interaction strength can affect the overall distribution of magnetizations. ASI are studied because of their potential applications as low-powered magnetic logic devices for computation and data storage. Statistics on the distribution of energy states within ASI of different nanomagnet size and spacing have been studied using magnetic domain images captured using an x-ray photoemission electron microscope. However, it is also useful to predict the dynamics of the relaxation patterns from a higher energy state to a lower energy state using simulations. In this study, Monte Carlo simulations are utilized to predict ground state magnetic configurations of square ASI systems using an Ising model of spins. This Monte Carlo routine has been developed to complement experimental results with theoretical simulations whose results along with experimental data can be used to predict and understand the fundamental thermodynamic nature of ASI systems.

Bilingual Skills and Executive Function: English-Spanish Bilinguals in Dual Language Immersion Programs

Jaqueline Jimenez
Sponsor: Yuuko Tonkovich, Ph.D.
Education

Existing research shows that executive function (EF) is associated with vocabulary, word reading, and reading comprehension. Past research has focused on monolinguals, but there is less research on bilinguals. Furthermore, research with bilinguals has mainly been conducted with bilinguals from low socio-economic status (SES) homes. To fill the gaps in previous research, this study examined 30 English-Spanish bilingual second-graders (14 boys,16 girls), from high SES English-speaking families, enrolled in a Spanish Dual Language Immersion program since kindergarten. EF was collected using the Dimensional Change Card Sort task on the NIH Toolkit. English and Spanish receptive vocabulary were collected using the Peabody Picture Vocabulary Test. Decoding and reading comprehension was collected with the letter-word identification and passage comprehension subtests of the Woodcock-Johnson Test in both languages. Results show that on average, bilinguals had higher English vocabulary than Spanish, but their Spanish skills were equivalent to age-matched peers. On average, bilinguals' Spanish word reading was higher than their English word reading. Correlational results show that EF was significantly associated with receptive and expressive English vocabulary, but not with Spanish. These findings give a better understanding of higher SES bilinguals' language, literacy and EF skills, disentangling the effects of SES and bilingualism.

Tri-Pack: a multi-functional wearable shelter for homeless individuals

Danielle Joelli
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

According to the United States Interagency Council on Homelessness, California has approximately 150,000 individuals experiencing homelessness. These individuals have multiple overlapping needs: unstable living conditions, protection from the elements, and the ability to change locations often and unpredictably. To address the needs of homeless individuals in a single, affordable, easily-transportable product, we are creating a multi-functional wearable shelter that provides protection while using materials that are upcycled and/or recycled. While products exist to provide mobile shelter in conveniently portable forms, to our knowledge, no product has simultaneously addressed the needs for daytime and nighttime shelter in a single product that also incorporates sustainable materials. Through qualitative interviews, secondary research, and user-testing, we have arrived at a prototype shelter that can also be worn as a garment and transformed into a backpack to hold other items. By combining multiple functions in this prototype, we aim to reduce the number of items an individual would need to carry in order to stay mobile and protected in various urban and rural conditions.

Immigration Policy Through the Eyes of Physicians

Isabella Johnson
Sponsor: Cristiana Giordano, Ph.D.
Anthropology

In the last decade, especially in the last 5 years, there has been an influx of research on the impact of US legal policies on immigrant health, but little research has been done to illuminate how the health practitioners that care for these patients react to those changes. It has been the aim of this work to shed light on their stories with the hope of better understanding what shapes patient-physician interactions. Thus, I have conducted a series of interviews, coupled with an independent literary review, to illuminate how immigration laws affect physicians as they care for this group of people. This research has been primarily conducted with physicians based in Oakland, Ca. The principle questions explored ask how laws impact their practices? Do they notice new policies, and if so, how have their practices changed? The practitioners responses range from increased political engagement to actively changing how they practice medicine to ensure their patients continued health. Particular focus has been given to the public charge law and the creation of a medical home.

New Constraints on Magmatic Architecture of the Oruanui Super Eruption

Adelicia Johnson
Sponsor: Kari Cooper, Ph.D.
Earth And Planetary Sciences

Large volcanic eruptions are climate altering events, affecting both local and global populations; however, the timeline of magma storage before eruptions is poorly understood. This study attempts to address this gap by reconstructing the erupted magma body of the last super-eruption, Oruanui in 25.4 kya, with trace-element analysis and ^{238}U-^{230}Th dating of zircon crystals from the USGS/Stanford SHRIMP-RG. Analysis of bulk zircon crystal faces, which preserve the most recent chemical signature of their magma reservoir, yielded two distinct trace-element populations that crystallized simultaneously. To investigate this phenomenon further, we analyzed zircon hosted within plagioclase to test if these populations are related to the host(plagioclase or melt) of the zircon. We found a range of compositions of plagioclase hosted zircon surfaces which overlaps both bulk zircon populations but span an even broader range, similar to the older interiors of the bulk zircon. We hypothesize that a single magma reservoir hosted the bulk zircon and the plagioclase hosted zircons before final growth of the melt-hosted zircon in two magma bodies. These data suggest accumulation of magma, and architecture of the system before eruption is more complex than previously imagined.

The Association Between Ethnic Identity Beliefs and Body Satisfaction in Ethnic Minority Groups

Nicole Johnston
Sponsor: Adrienne Nishina, Ph.D.
Human Ecology

The United States has long adhered to Eurocentric standards of beauty. In recent decades, the United States has experienced an increase in diversity, raising the question of how belonging to an ethnic minority group may relate to one's body satisfaction, as their body type may not be represented as frequently in popular media. This relationship may be especially prevalent among adolescents, who are can be impacted by social comparisons. The current study asks how belonging to an ethnic minority group relates to body satisfaction among high school students, as well as the role of their ethnic identity beliefs in this association. We draw data from a quantitative multi-year study of 671 adolescents (ages 13-16; 45.9% girls; 28% White, 25% Latinx, 17% multiethnic, 15% Asian American, 5% African American). Preliminary ANOVA results indicated that body satisfaction levels were similar across ethnic groups in our sample ($F(7, 316) = 1.66$, $p=.12$), and correlation analyses indicated that feeling as though ethnicity was an important part of your self-image (i.e., centrality) positively related to girls' body satisfaction beliefs ($r = .17$, $p= .028$). These findings suggest that school interventions aiming to improve students' body satisfaction beliefs could emphasize ethnic identity centrality.

Effects of Fetal Growth Restriction on Iron Homeostasis in a Neonatal Pig Model

Amanda Jones
Sponsor: Peng Ji, Ph.D.
Nutrition

Iron is a critical mineral for postnatal growth and development. To investigate the effects of intrauterine growth restriction (IUGR) on postnatal iron metabolism, we are using a neonatal pig model; a valuable translational model to human infants. Piglets born small or appropriate for gestational age (SGA or AGA, n = 8 or 6) will be euthanized on postnatal day 1-2. Tissue samples from duodenum, liver, and various regions of the brain will be collected and extracted for total RNA and protein. Hepatic iron content, hemoglobin, and hematocrit will be determined to assess iron statuses in each piglet. Using RT-qPCR and protein expression of the ferritin heavy chain in the liver through western blot, we will analyze the mRNA expression of genes encoding ferrireductase (DCYTB), iron transporters (DMT1 and FPN1), transferrin receptor (TFRC), and hepcidin (HAMP) in the duodenum and/or liver. Analysis of mRNA and protein expression will shed light on the homeostatic regulation of iron metabolism in SGA and AGA piglets. Results from our study will unveil the impact of IUGR on fetal iron accumulation, working toward better nutritional support strategies for SGA and AGA infants.

Can Competition Explain the Paradox of Two California Endemic Annuals?

Evan Jordan
Sponsor: Sharon Strauss, Ph.D.
Evolution & Ecology

There are numerous reasons why species in the wild might not intermix, despite being in the same area at the same time. The two closely related annual species Streptanthus hesperidis and Streptanthus breweri provide a curious example of spatial distribution in that they grow very locally on the same serpentine soil outcrops with populations only tens or a hundred meters apart, and they occupy very similar niches, yet they have rarely been seen to intermix in the wild. With help, I have investigated local adaptation and subsequent competitive advantage as a potential explanation for this apparent paradox. Individuals of these species were grown in a screenhouse mimicking natural conditions. Over eight months they were grown alone and in competition on the native soils of each species. During this time, I hand-pollinated flowers and periodically measured proxies for fitness, including stem length and number of reproductive structures. After most plants had senesced, fitness was measured again, including root and shoot biomass. Statistical analysis has revealed trends, some significant, of local adaptation producing competitive advantage for individuals on their native soil, despite their close proximity.

Using Genetic Knockouts to Increase Meiotic Recombination in Lettuce

Nina Jorgensen
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Meiotic recombination plays a critical role in sustaining genetic diversity within populations, but little is known about its regulatory mechanisms. Double strand breaks (DSBs) in DNA are repaired during meiosis to form crossovers or non-crossovers on chromosomes, but most are repaired as non-crossovers. Recently, several anti-crossover regulatory genes have been identified, including the RECQ4 helicases. Non-functional mutations of these genes in several plant species result in a genome-wide increase in crossover frequency. Lettuce (Lactuca sativa) is a popular vegetable in the American diet and has a high economic value. Increasing meiotic crossovers will speed up breeding programs for improving disease resistance, tolerance to environmental stress, and other desirable traits. The lettuce genome encodes two RECQ4 helicases, RECQ4A and RECQ4B. In my research, I am exploring the effect of knocking out RECQ4B on meiotic recombination in lettuce. I am using Golden Gate cloning to create plasmids encoding Cas9 along with multiple guide RNAs (gRNAs) directed toward RECQ4B to increase the likelihood of its disruption after transformation into lettuce plants. I hypothesize that this should result in an increase in meiotic recombination genome-wide, perhaps promoting recombination in regions of the genome where it is rare and creating novel trait variation in lettuce.

Safety and Efficacy of Lenvatinib in Patients with Child-Pugh B Advanced Hepatocellular Carcinoma

Anjali Joseph
Sponsor: May Cho, M.D.
MED: Int Med Hem/Onc

Lenvatinib was recently approved as a first-line therapy for advanced hepatocellular carcinoma (aHCC), although 99% of patients included in the study leading to approval had Child-Pugh A liver function, restricting its use to this patient population. The purpose of our study is to describe the safety and efficacy of lenvatinib in patients with Child-Pugh B (CP-B) aHCC. We performed a multicenter, retrospective study of 16 patients who received ≥1 dose of lenvatinib for CP-B aHCC. Response was assessed based on mRECIST for HCC or clinical progression. Safety was assessed using CTCAE v4.0. In this small retrospective study of 16 patients, toxicities were frequent and dose related. A dosage of 8 mg daily was associated with better tolerance than 10 mg and 12 mg daily in CP-B patients, which is in line with previously published phase 1 data. Low dose lenvatinib could be a potential treatment option for this patient population; however, efficacy and safety will need to be validated in a prospective trial.

Continuous Chest Compressions With Asynchronous Ventilations Increase Cerebral Blood Flow

Houssam Joudi
Sponsor: Payam Vali, M.D.
MED: Pediatrics

Current guidelines recommend interrupted chest compressions (CC) at a 3:1 compression-to-ventilation (CV) ratio in severely bradycardic newborns. In neonates, heart rate is the primary determinant of cardiac output and achieving higher CC rates may increase blood flow. We hypothesize that continuous CC with asynchronous ventilations (CCCaV) leads to quicker return of spontaneous circulation (ROSC) and better hemodynamics compared to 3:1 CV resuscitation. Sixteen near-term lambs (142/147d) were asphyxiated by cord occlusion to cardiac arrest. Lambs were randomized to 3:1 CV or CCCaV (120 CC/min and asynchronous ventilations at 30/min). After 5min of asystole, ventilation was provided by a T-piece resuscitator with CC started after 30s. First epinephrine dose was given at 6min if ROSC was not achieved. No differences seen in baseline characteristics between groups. Incidence and time of ROSC was similar in both groups. Lambs that received CCCaV had significantly greater left carotid blood flow compared to 3:1 CV (8.1 ±3.3 vs 5.3 ±2.5 ml/kg/min, p= 0.01). There was no difference in systolic, diastolic and mean BP between groups. In this model, CCCaV showed greater carotid blood flow compared to 3:1 CV resuscitation. Clinical studies assessing the neurodevelopmental outcomes comparing CCCaV to 3:1 CV during newborn resuscitation are warranted.

Understanding the Role of *hsp-3,4* in Positioning the Spindle and Sperm Contents in Fertilized Meiotic C. elegans Embryos

Iris Juanico
Sponsor: Francis Mcnally, Ph.D.
Molecular & Cellular Bio

In most animals, the meiotic division of the maternal DNA in the embryo is completed after fertilization by sperm. In C. elegans, the maternal meiotic spindle and sperm contents are kept on opposite ends of the embryo despite cytoplasmic streaming. This is thought to be important because exclusion of sperm DNA from the spindle may prevent chromatid division errors. This observation led to an investigation of the possible mechanisms tethering both the sperm contents and spindle. We hypothesize that the endoplasmic reticulum (ER), a membranous organelle that extends throughout the cytosol, has a role in maintaining the correct position of the sperm contents and meiotic spindle in the C. elegans embryo. This hypothesis is based on the fact that the ER is tethered to other membranous organelles by specific protein complexes, suggesting that it generates a structural scaffold in the cell. We found that depletion of the ER luminal protein BiP, encoded by hsp-3,4 in C. elegans, strongly disrupted ER structure. Depletion of these proteins caused mispositioning of the spindle but not sperm contents. Live imaging of the spindle and ER during meiosis will clarify the role of the ER.

Using Noninvasive Ultrasonography to Evaluate the Effect of Temperature on Black Abalone, *Haliotis cracherodii,* Gonad Development

Alexes Juarez
Sponsor: Jason Gross, Ph.D.
Anr Animal Science

Black abalone, Haliotis cracherodii, is a critical species in stabilizing Californian intertidal ecosystems. However, a combination of environmental stressors, disease, and overfishing has led to a population collapse culminating in an endangered species listing in 2009. To begin conservation and restoration efforts, noninvasive methodology is needed to characterize reproductive biology. The objective of this project is to noninvasively evaluate the effect of ocean temperatures on black abalone reproductive biology. Specifically, this project aims to: 1) determine the effects of increasing ocean temperatures and nutrient status on gonad development in red abalone as a surrogate species using ultrasound technology and 2) apply the technology to identify the effect of temperature and nutritional state on black abalone gonad development. The specimens will be distinguished by size and sex. Once divided, animals will be exposed to three treatments of water. Once in respective treatments, animals will be measured monthly using ultrasonography. After the methodology is optimized, it will be applied in the black abalone trials. The results will be useful to Californian Abalone Fisheries. Information on reproductive biology will give industry insight in the decision of utilizing wild individuals for consumption, or to switch to offshore aquaculture methods.

An Early 20th Century Understanding of Syria: *Through the Glass Stained Lens of the* Church, an Analysis of the Term "Syria" in the New York Times (1900-1909)

Nancy Juarez
Sponsor: Suad Joseph, Ph.D.
Anthropology

My research analyzes the New York Times' (NYT) representation of the Middle East from 1900 to 1909. I employed the method of database research through the ProQuest advanced search engine and proceeded to search the term "Syria*" for relevance to the Middle East. A notable trend that has revealed itself is the representation of Syria through the lens of ecumenical missionaries. Employing this lens, Syria is only Syria when in reference to the Church, but in every other regard it is the "Eastern world". I argue that this trend in reporting perpetuates the colonial idea that Middle Eastern peoples' have no cohesion, legitimate claims to identity and land, or in other words, that they are unidentifiable unless viewed through the scope of Ecumenism. These misrepresentations depict Syria as a land in need of saving from itself. The broad scope of the research project is to examine the genealogical representation of Muslims, Arabs, and Islam through a 150-year analysis of what is considered to be a leading newspaper in the United States.

On the Cross-Linguistic Portrayal of Suffering: Martyrs, Chronic Illness, Disability and Masculinity in French and English

Kelly Kagawa
Sponsor: Eric Dickson, Ph.D.
French & Italian

My research is an investigation of that which distinguishes French and English linguistic portrayals of suffering within various contexts. In this presentation, I will focus on the semantic components of divine suffering in the Bible, utilizing editions in both languages. In French and in English, the agent and receiver of actions conveyed through language are often vastly different, potentially altering the mental conception of suffering and its societal portrayal, and the stigma or veneration that can be associated with it. Catholicism and the French language comprise fundamental aspects of many cultures, due to their historical influence. The broader project incorporates the topics of masculinity, disability, and chronic illness as well. As an individual who has grown up with multiple chronic illnesses, I have contemplated how the perception of the self can be altered by how language is employed to explain biological phenomena. This can be particularly nuanced in the depiction of autoimmune diseases, where the immune system perceives part of the very body it defends as a threat. For those who do not identify with their assigned genders, the concept of the self becomes incredibly complex, due to the preexisting conflict between the body and the mind.

The Role of *anc-1* in Nuclear Anchorage

Shilpi Kalra
Sponsor: Daniel Starr, Ph.D.
Molecular & Cellular Bio

Nuclear mispositioning is a common feature in diseased myofibers. We study nuclear anchorage in the multinucleated hypodermis of Caenorhabditis elegans. The linker of the nucleoskeleton and cytoskeleton (LINC) spans the nuclear envelope (NE) and anchors the nucleus through ANC-1 KASH and UNC-84 SUN protein interactions. Disrupting the SUN/KASH interaction results in less severe nuclear defects than a null mutation of the anc-1 gene. Thus, we hypothesized that ANC-1 operates independently of LINC. ANC-1 has a transmembrane (TM) domain followed by the C-terminal luminal KASH domain. I used CRISPR-Cas9 to delete the TM and KASH (TK) domains. The TK deletion resulted in greater nuclear defects than the KASH or SUN deletions alone, indicating that the TM domain plays a significant role in LINC-independent nuclear positioning. ANC-1 localizes to the NE and potentially the ER. We hypothesize that deletion of the KASH domain removes the protein from the NE while the additional deletion of the TM domain also disrupts the ER localization. To test this, I deleted the KASH domain and TK domains in the mKate2::anc-1 background to characterize the protein localization. I am currently comparing nuclear shape, brood size, and worm size between the wild-type and mutant worms.

Development of a Novel Propulsive Lunar Mobility and Lunar Gravity Emulating Platform

Balram Kandoria
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the system design and concept of operations of the Lunar Emulated Hopper Platform (LEHoP), an Earth-based testbed for lunar mobility systems designed for NASA's BIG Idea Challenge 2020. With NASA putting humans back on the Moon by 2024, lunar surface exploration represents a critical component of lunar infrastructure due to necessary tasks such as locating water ice deposits. Due to these deposits most commonly occurring in the rough terrain of the permanently-shadowed regions of large craters, land rovers face significant mobility challenges and thus alternate transportation methods may be preferable. Our approach consists of a propulsive "hopping" device that ejects warm gas to enter flight, traverse terrain, and land while carrying small scientific payloads. The propulsive system utilizes unique, medium flow-rate resistojet thrusters and a ducted fan apparatus which emulates lunar gravity on Earth. Successful development of such a platform could lead to the generation of best-practices in hopper design, which would benefit future lunar exploration endeavors.

In vitro study of reduced graphene oxide toxicity in corneal fibroblast and epithelial cells

Jennifer Kang
Sponsor: Atsuhiko Fukuto, M.D.,Ph.D.
Cntr For Health & Environment

Reduced graphene oxide (RGO) nanoparticles (NPs) have shown an increase in applications due to their electrochemical and physicochemical properties. They are used in solar cells, drug delivery, and biosensing with potential biomaterial use. The inevitable contact between the eyes and RGO NPs in the environment can lead to potential ocular damage. However, there is still a lack of information regarding the toxicity of RGO NPs and their effects on corneal wound healing. This study aims to evaluate the in vitro effects of RGO NPs on cell viability and migration. Cell viability was assessed in rabbit corneal fibroblasts (RCFs) and immortalized human corneal epithelial (hTCEpi) cells using Calcein AM assays. Cell migration assays were carried out to investigate migration of hTCEpi cells after 24-hour exposure to different concentrations of RGO NPs. Cell migration is a crucial property of cornea because corneal epithelial cells must be able to regenerate following acute damage. Cell viability was significantly decreased at concentrations ≥2.5 µg/mL in hTCEpi cells and ≥12.5 µg/mL in RCFs. Migration was significantly inhibited at concentrations ≥5 µg/mL.

Archaeoforensic Analyses of Human Tissues from Two 1850s Californians

Nikoletta Karapanos
Sponsor: Jelmer Eerkens, Ph.D.
Anthropology

This archaeoforensic study develops life histories for two "John Doe" cases from Central California. Both represent Anglo-American individuals dating to the 1850s, one child from the Folsom area, and one adult from San Francisco. The cemeteries where they were buried were exhumed in the early 1900s during urbanization, but these individuals were inadvertently left behind. Removal of headstones and other cemetery markers during exhumation means that burials like these have no identifying information. Unfortunately, this is an all-too-common finding during construction activity in the vicinity of former cemeteries. Stable isotope analyses on preserved human tissues, such as bone, teeth, and hair, can provide evidence of lifestyle patterns, including diet, place of residence during different phases of life, and season of death. Data from teeth gives information from the first 22 years of a person's life, while bone provides data on the last 5-15 years of life. Analysis of proteins preserved in teeth can reveal the sex. By combining the life history data with historical documents, we may be able to learn the identities of these individuals. The life history data will also contribute to our knowledge of what life was like for California immigrant families in the mid-19th century.

Developing and Measuring the Effectiveness of an Antibody Screen for Cytomegalovirus Detection in Rhesus Macaques

Harsharonjit Kang
Sponsor: Jeffrey Roberts, Ph.D.
VM: Medicine & Epidemiology

Macaques are used as animal models in human biomedical research because both species share similarities. For example, cytomegalovirus (CMV) can be transmitted from mother to offspring in humans and macaques. Although human and rhesus CMV are different viruses, they can both lead to disease congenitally or within the immunosuppressed host. Detecting CMV in rhesus macaques is important for animal health, reproduction, and for lowering risks of pathogen transmission, including zoonotic exposure in research colonies. There are many ways to detect CMV within macaques including culture, antibody detection, or PCR detection. We developed and measured the effectiveness of detecting CMV by an antibody screen. To date, we have tested immunoassays using two different antigen concentrations bound to polystyrene beads or magnetic beads. After trying various combinations, we found that results are dependent on the quality of the antigen, and we're currently validating a protocol using 50 µg of antigen on magnetic beads. Results on a panel of 30 samples tested were accurate when compared to reference methods. Because CMV elicits an immune response, it has been studied as a vaccine vector. Thus, detecting CMV in macaques is important because it can be a confounding variable in interpreting research results.

Cloning Resistance Genes in Lettuce Using Downy Mildew Effectors

Lily Karim
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Lettuce downy mildew is a plant disease caused by the pathogenic oomycete Bremia lactucae. B. lactucae enhances infection by secreting effector (Avr) proteins into lettuce cells. Lettuce plants with innate resistance to downy mildew contain resistance (R) genes. These resistance genes produce resistance proteins that, upon recognition of an effector protein, induce a hypersensitive cell death response (HR) that prevents the spread of the pathogen by causing cell death in the infected area. This research aims to identify functional R genes from candidate R genes, which poses a challenge because they are highly clustered in the lettuce genome. To facilitate the identification process, we utilize previously cloned Avr genes by co-expressing them with candidate R genes. If subsequent HR is observed, then it can be established that the candidate gene is a true R gene. Through this method, we have recently identified an Avr-R gene pair that induced HR. Our ultimate goal is to construct a library of Avr-R gene pairs, which would enable stacking of the most relevant R genes in lettuce to counteract infections from B. lactucae.

Children's Parasympathetic Activity and Self-Reported Anxiety Following Acute Stress

Mona Karimi
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

Prior studies have examined the relation between respiratory sinus arrhythmia (RSA), an index of parasympathetic nervous system activity, and the regulation of anxiety, in which low baseline RSA is associated with higher anxiety levels. However, most of this research has been limited to adult populations. Much less is known about children's physiological patterns. This study aims to address this gap by examining children's self reported anxiety and RSA reactivity and recovery when presented with an acute social stressor, the Trier Social Stress Test modified for children (TSST-M). Participants (N = 182, ages 9 to 11) were randomly assigned to one of three conditions involving exposure to the TSST-M or an alternative activity: (1) in the alone condition participants prepared for the TSST-M alone, (2) in the parent condition participants prepared for the TSST-M with a parent, and (3) in the control condition participants engaged in a no-stress puzzle-solving task in lieu of the TSST-M. RSA levels were assessed using an ambulatory electrocardiogram. We will examine participants' self-reported anxiety following the TSST-M, or alternative activity, and its linear relation between RSA reactivity and recovery. This study has the potential to increase our understanding of the psychophysiological underpinnings of anxiety in children.

Nutrition and Health Claims on Online Grocery Websites

Abraham Karimi
Sponsor: Jennifer Falbe, Ph.D.
Human Ecology

Online shopping is becoming increasingly prevalent, especially for groceries. It is important to analyze how online retailers are displaying product information in this new and developing area. The current study looks at how websites describe foods they sell using nutrition and health claims, statements, and symbols on their websites. Three types of claims were analyzed: nutrition claims, health claims, nutrient restatements (e.g., repeating nutrient values outside of the Nutrition Facts table). A total of 456 products across 15 different retailers were compared. Products were divided into two categories: "poor nutritional value" vs. "moderate or high nutritional value." Items with high added sugar, sodium, and/or saturated fat content were categorized as having "poor value." Overall, 20% of items sampled had a nutrition claim, 9% had a health claim, 31% had a repeating nutrient value. Health claims were more frequent for "moderate/high value" products than "poor value" products ($P<0.05$). There were no other significant differences between "poor" and "moderate/high value" products. These results may be due to retailers' and/or manufacturers' willingness to mention any type of claim to make a product more appealing.

Simple Fabrication of Robust Colorimetric Sensors Through Chemisorption for Ammonia Gas Detection

Nadia Kaspersky
Sponsor: Gang Sun, Ph.D.
Biological & Ag Engineering

Sensors for environmental hazards have always been important. Recently, particular attention has been put on sensors made from nanofibrous membranes for their flexibility, lightweightness, portability, and ultrasensitivity due to the ultrahigh specific surface areas. In this study, a cationic nanofibrous membrane was fabricated through electrospinning of a poly(4-vinylpyradine) and polyacrylonitrile emulsion and followed with a chemical modification with 2-diethylaminoethyl chloride. The modification reaction created a large amount of positive charges on surfaces of the membranes which are able to act as a novel sensor matrix. The positive sites can be further decorated with anionic colorimetric probes by electrostatic interaction. As a proof-of-concept study, phenol red, a pH indicator, was selected and adsorbed onto the as-fabricated sensor matric for ammonia gas detection. The adsorption process was studied experimentally. A colorimetric sensor made of the membrane showed ultrahigh sensitivity to ammonia and triethylamine vapors, whose limit of detection reached 1 ppm and 5 ppm, respectively, with a response time of <10 seconds. The sensor also showed good reusability for up to 20 cycles of repeated detections. More importantly, the results presented a high promise for designing broad-spectrum of colorimetric sensors based on this cationic nanofibrous membrane through simply yet strong chemisorption.

Effectiveness of Etravirine and Sunitinib-based Therapy for Cell Lines Resistant to ER Stress

Harikumara Kathi
Sponsor: Jeremy Chien, Ph.D.
MED: Biochem & Molecular Med

Valosin-containing protein VCP (p97) is a hexameric, type II ATPase of the AAA family that mediates disparate cellular functions, including endoplasmic reticulum-associated degradation (ERAD). We have previously used HCT-116 colon cancer cells to generate cells (CB9) that are resistant to a VCP inhibitor CB5083. To overcome this resistance to CB, we performed a single-dose (5 microM) drug screen consisting of approximately 400 FDA-approved drugs to identify those that showed enhanced cytotoxic effects in CB9 cells. After identifying Etravirine (ETR) and Sunitinib as our initial hits, we treated both the parental and resistant cells with drug concentrations ranging from 0-10 microM and performed dose-response studies using CellTiter-Glo. Our dose-response studies show that ETR has a significantly higher IC50 in HCT116 parental cells relative to CB9 cells. Upon Sunitinib treatment, however, there was no significant difference in the IC50's between the HCT-116 parental and the CB9 cells. Colorectal carcinoma is the third most common and fourth most lethal type of cancer thus warranting an immediate need for developing new therapeutics that can overcome existing resistance mechanisms in cancer cells. Although resistance to CB5083 is rapidly acquired in vitro, resistant cells acquire new dependencies that can be exploited with HIV drug etravirine.

The Effects of Wearable Accelerometer Placement on the Magnitude and Timing of Acceleration Peaks

Zachary Katzman
Sponsor: David Hawkins, Ph.D.
Neuro Physio & Behavior

Overuse injury rates are high among the >55 million Americans who run. Wearable devices provide exciting opportunities for runners to track mechanical metrics (e.g. accelerations) that can be used to provide real-time feedback and early interventions which may prevent overuse injuries. The effects of wearable accelerometer placement on acceleration magnitude and timing must be understood in order to develop effective diagnostic and therapeutic tools based on acceleration data. Unfortunately, this information is not currently available. The purpose of this study is to quantify changes in the magnitude and timing of acceleration peaks caused by variation in wearable accelerometer placement. Runners (n=73) completed 60 running trials each, while a pair of accelerometers, placed 5.2 cm apart at one of three commonly investigated anatomical locations (sacrum, iliac crest, or distal tibia), simultaneously collected data. Acceleration data are currently being processed to determine the effects of device placement, and these results will indicate whether or not a shift of just 5.2 cm significantly affects peak magnitude and timing.

Problems Associated with Western Blotting Molecular Weight Standards

Ajuni Kaur
Sponsor: Aldrin Gomes, Ph.D.
MED: Physiology & Membrane Biol

Western blotting protein standards are pre-stained protein markers of known molecular weight (MW) or molecular mass (kDa). They are primarily utilized for sodium dodecyl sulphate (SDS) Polyacrylamide Gel Electrophoresis to determine the molecular mass of proteins separated by electrophoresis. The objective of this study was to assess five different protein standards to determine their reliability in predicting accurate protein masses. We performed this experiment by running CriterionTGX gels with different protein markers and purified proteins of well-established molecular weights. The protein standards used were Precision Blue Plus, Precision Plus protein Dual-color, Spectra Multicolor, Novex Sharp Pre-stained, and Invitrogen iBright Pre-Stained. To evaluate their precision we use BSA (66.5 kDa) and Cytochrome C (12 kDa). We concluded that the iBright Pre-stained marker had the highest error in determining expected protein molecular weights. SeeBlue Plus Standard was accurate at identifying proteins with higher molecular weights but was less reliable for lower molecular weight proteins. These findings have significant implications for the determination of protein masses because researchers rely on these standards to evaluate the molecular masses of their protein(s). We suggest that at least two standards should be used in electrophoresis gels in order to get accurate protein molecular weight results.

Individual Writing Versus Group Writing: What are the Advantages and Disadvantages

Navleen Kaur
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

In this research project, I investigate academic writing approaches by comparing two specific types which are commonplace at the university level. I will study individual writing assignments and their benefits and drawbacks, then compare them to group writing. It wasn't until I participated in a group writing assignment this quarter that I came to realize that there are many benefits and challenges I face when writing individually that are different from when I write in a group. My personal findings included, but are not limited to, writing individually flows better and is more uniform in writing technique and style, whereas writing in my group seemed to be "easier" because the workload was distributed. To see how others feel in regard to these two writing styles, I conducted a series of surveys and interviews with UC Davis students to better understand the advantages and disadvantages of each type of writing. Comparing individual writing to group writing is essential because it provides insights that are helpful to both teachers and students. These findings may help gauge teacher expectations from student assignments, and they are relevant to students because they can help students understand and prepare for each writing type appropriately.

Developing a Reference Sequence Library for Mexican Free-Tailed Bat Prey

Shayan Kaveh
Sponsor: Andrea Schreier, Ph.D.
Animal Science

An estimated 250,000 Mexican free-tailed bats (Tadarida brasiliensis) reside in the Yolo Bypass which supports rice agriculture, one of the most important crops in the world. Mexican free-tailed bats provide ecosystem services to local farmers by consuming agricultural pests. Working with Ecology graduate student Ann Holmes, we collected ~300 guano samples in summer 2019 to determine diets of Mexican free-tailed bats. Previous studies determined diets through dissection and morphological identification, but identifying digested prey is difficult. With genetic techniques we can refine prey identities, but we need prey reference sequences to compare with DNA sequences extracted from guano. Reference sequence libraries provide a collection of genetic barcodes that allow the matching of DNA to species. This project will develop a reference library of regional agricultural pests. Insect sequences will be found through searches of genetic databases such as GenBank and Barcode of Life. Insects not genetically databased will be Sanger sequenced and accessible to other researchers. If time permits, we will expand our study using quantitative PCR (qPCR) genetic assays to see if these organisms are present in extracted DNA from bat guano. This research will help identify the contribution of Mexican free-tailed bats to local and sustainable agriculture.

The Recolonization of Microbial Communities on Eelgrass Roots After Bleach Surface Sterilization

Mackenzie Kawahara
Sponsor: John Stachowicz, Ph.D.
Evolution & Ecology

Host-microbiome relationships influence how a host organism responds to and influences its environment. Changes to plant microbial interactions may affect the ecosystem services provided by the host plants including nutrient cycling, carbon sequestering, and habitat formation. We investigated the recovery of the microbiome in a foundation species, Zostera marina (eelgrass), after a disturbance to assess its microbial community change. To test the effects of initial microbial community on community re-assembly (aka priority effects), we eliminated the entire microbial community by surface sterilizing the eelgrass roots in a dilute bleach solution. By comparing to control roots only rinsed in water, we show how microbiomes assemble de novo on eelgrass roots. Plants were grown in field-collected sediment in the lab for four weeks before we sequenced the root microbial community using the V4-V5 region of the 16S rRNA gene. Removal of the initial microbes by bleaching had no effect on the alpha or beta diversity in eelgrass associated microbial communities. This result demonstrates that priority effects have minimal influence on the recolonization of eelgrass root microbiomes after a disturbance.

Economic Causes and Consequences of the U.S.-China Trade War

Ruyi Ke
Sponsor: Bagher Modjtahedi, Ph.D.
Economics

In 2018, the U.S. government under President Trump unexpectedly increased tariffs on the imports of several goods from China, which caused China to retaliate immediately by increasing tariffs to the imports of some goods from the U.S. This is a classic example trade war. Our research will focus on specific economic causes and consequences of this U.S.-China trade war. To understand the root cause of this problem, we will study the history of economic conflicts between these two countries in recent years. Like any trade war, to understand the U.S.-China economic conflicts it is necessary to study the trade policies adopted by these countries in the years leading to the current situation. These policies include tariffs on imported goods, subsidies on exported goods, as well as policies related to foreign investment. Furthermore, using data published by international organizations, we will try to quantify the short-run and long-run economic effects of these recent trade wars on the economies of the two counties.

Comparing the Thermodynamic and Kinetic Properties of Interspecies ß-Glucosidase Enzymes

Alexander Kehl
Sponsor: Justin Siegel, Ph.D.
MED: Biochem & Molecular Med

The ability to accurately model enzyme activity and stability can positively impact the protein engineering community. Progress in this field is limited by the availability of large datasets containing quantitative kinetic constants and thermal stability measurements. Previously, quantitative data for 129 designed mutants of a glycoside hydrolase was published by the Siegel lab. This study indicated that functional Tm is independent of kcat, KM, and kcat/KM in this system, demonstrating that functional parameters of individual mutations are regulated independently. Here I report measurements of soluble protein expression in E. coli, thermal stability, and Michaelis-Menten constants (kcat, KM, and kcat/KM) of 40 ß-Glucosidase mutants from 4 different species. ß-Glucosidase is an enzyme that catalyzes the hydrolysis of glycosidic bonds that result in the release of glucose. I used immobilized metal affinity chromatography to purify the enzymes I produced. I colorimetrically assayed their thermostability and catalytic efficiency. The dataset will be used to test the accuracy of computational predictions of protein stability across a family of proteins using the established Rosetta and FoldX algorithms. Additionally, this will provide a foundation to move enzyme activity and stability predictions into an interspecies space.

Life Cycle Reversal Potential in Moon Jellyfish

Jashanpreet Khaira
Sponsor: David Gold, Ph.D.
Earth And Planetary Sciences

The moon jellyfish exhibits a complex life cycle where stationary polyps metamorphosize into free-swimming medusae. Preliminary evidence suggests that Aurelia might be capable of performing life cycle reversal that allows it to revert back to the polyp stage directly from the medusa. However, the environmental conditions under which this process occurs are still unclear. The purpose of this study is to validate life cycle reversal in the moon jellyfish Aurelia and determine which tissues drive this process. In this study, the medusa body will be divided into several pieces representing the major tissue structures. These pieces will then be collected in a tank and exposed to physical stress through starvation. Successful formation of polyp colonies from the degrading medusa could lead to the classification of Aurelia as a biologically immortal species, making it a valuable model for investigating fundamental processes in the biology of aging. This characteristic could also result in an increased interest in genes and cell processes that aid in reverse aging and carry pharmaceutical applications.

Multiwalled Carbon Nanotube Particles Affect on the Lungs

Hufssa Khan
Sponsor: Laura Van Winkle, Ph.D.
Cntr For Health & Environment

MWCNT (Multiwalled Carbon Nanotubes) are nanoparticles arranged in concentric tubes. The tubes are composed of an allotrope of carbon similar to flat graphene sheets that have been rolled into a cylinder. This material is being used in consumer products and increasing human exposure may lead to potential health risks. This study tested the effects of MWCNT on the lungs of rats. We measured the expression of specific genes, IL6, Cxcl2, PCNA, TgfD1, and SftPD, in whole lung tissue using qRT-PCR with HPRT1 as a housekeeper. This experiment compared the controls with 0 exposure to 0.6 [mg/m^3] exposure samples. Each treatment had an "N" of 5. RT-PCR performed on cDNA made from RNA extracted from homogenized pieces of a whole lung lobe found no treatment related responses. Because lung responses are different by region, in a second attempt, we used laser capture microdissection to study regional responses of terminal airway, proximal airway, and parenchyma. At least 1,000,000 microns^2 area of each lung region was collected from each sample using laser capture microdissection. RT-PCR was performed on the resulting cDNA. Treatment related responses were detected in the cDNA from the collected parenchyma and not the airway.

The Middle East and North Africa in U.S. Media Representations: An Analysis of the Term "Tunisia" in the New York Times (1900-1909)

Shoshana Khan
Sponsor: Suad Joseph, Ph.D.
Anthropology

Through extensive analysis on New York Times articles' representation of the term Tunisia, I concluded that New York Times authors consistently depict Tunisia and Tunisian people as simple and exotic that is meant to contrast with complex and developed Western countries. Authors routinely carry a condescending tone that patronizes and simplifies Tunisian people to backwards and facile creatures incapable of surviving in the modern world. Many consider the New York Times to be the leading nation-wide liberal newspaper. My research analyzes the representation of the Middle East using New York Times articles in the decade 1900-1909. I specifically focused on articles relevant to the term Tunisia through the Proquest Historical Newspaper Database. As I found, this representation is crucial during this time period to aid the French in justifying their colonial rule in Tunisia. This research is part of a larger project analyzing 150 years of the New York Times's representation of the Middle East conducted in Dr. Suad Joseph's lab.

The Individual's Influence on Collective Action and Climate Change: Exploring Intentionality, Temporality, and Fertility in Karen Tei Yamashita's *Through the Arc of the Rain Forest*

Adeline Kikut
Sponsor: Margaret Ronda, Ph.D.
English

This project uses Karen Yamashita's novel Through the Arc of the Rainforest to offer a glimpse into the many ways humans, intentionally or not, make decisions that aggregate to cause environmental destruction. Climate is both an ecological process like weather and physical environments and also the ways those natural processes facilitate a set of social relations. Anthropocentric climate change, then, involves both a collection of human actions and also an alteration of the ecological processes to support a collective sociality. Yamashita's novel uniquely forces a hyperawareness of climate change by highlighting the myriad human actions and interactions that accumulate to influence a change in climate and displaying the multifaceted consequences simultaneously, even when, in reality, these consequences are temporally dissociated. Moreover, the simultaneous temporality emphasizes the instability of the future by juxtaposing human, generational time with ecological, geologic time. The novel emphasizes human reproduction, both commercial and biological, which in turn explicitly denies Nature fertility, and therefore the ability to recover from intentional, malicious human action. Yamashita's novel provides a platform to explore the interactions that accumulate to cause global climate change and the implications of those changes on the possibilities for the future.

Pneumoconiosis in Island Foxes (*Urocyon littoralis*)

Fiona Kilby
Sponsor: Leslie Woods, D.V.M.,Ph.D.
Ca Animal Hlth&food Safety Lab

Island foxes (Urocyon littoralis) are located on six of the eight-island archipelago of the Channel Islands, each with its own subspecies. Once on the brink of extinction, a highly coordinated captive breeding program and ecosystem restoration project resulted in the fastest recovery of an endangered mammal in United States history. The purpose of this project is to determine if island foxes on San Clemente Island are contracting pneumoconiosis at a higher rate of frequency and severity than the other subspecies. Preliminary data supports the hypothesis that pneumoconiosis presents itself in a disproportionate manner on San Clemente Island. This is being researched through literature review, necropsy case files, and histopathological scoring. At the conclusion of this study, a scale of the severity of pneumoconiosis will be complete. If possible, a map of the GPS locations where the fox carcasses were found will also be created. This research explores how pneumoconiosis affects air exchange within the lung. Research on pneumoconiosis in the island fox may shed light on potential health risks for humans exposed to the same environment. To the authors' knowledge, this is the first paper addressing pneumoconiosis in foxes.

Fun with Fungi: Mitotic Recombination in *Botrytis cinerea*

Sydney Kim
Sponsor: Daniel Kliebenstein, Ph.D.
Plant Sciences

Botrytis cinerea is a major agricultural pathogen that causes billions of dollars worth of crop damage worldwide. This fungus infects a wide range of fruit and vegetables before and after harvest. Phenotypes such as pigmentation, growth rate and spore production show a wide array of diversity in B.cinerea. This large genetic diversity may indicate a rapid evolution rate via recombination. However, the sexual cycle of Botrytis is a rare event in nature. There is a possibility of mitotic recombination occurring, which would generate this genetic diversity displayed in Botrytis. Our aim is to confirm the development of mitotic recombination in a controlled lab setting. Distinct isolates of Botrytis cinerea were added incrementally (combinations of two through eight different isolates) on plates and Arabidopsis thaliana leaves. This creates unique single spore isolates that were collected, grown and phenotyped. DNA extraction, PCR, and gel electrophoresis were used to view microsatellites. Microsatellites allow us to compare the potential mitotic recombinants with their parental isolates. We have observed distinct phenotypes and performed genetic analysis to confirm mitotic recombination. Understanding how Botrytis generates diversity will improve management strategies for growers.

Brettanomyces Spoilage in Aged Wines from Argentina

Heesun Kim
Sponsor: Lucy Joseph, Ph.D.
Viticulture & Enology

Yeast play an integral part in winemaking by producing alcohol as well as secondary metabolites that enhance the flavor and aroma of wines. However, some yeast are also capable of causing wine spoilage problems which reduce the quality and the value of wine. Brettanomyces bruxellensis can produce undesirable volatile compounds such as 4-ethylphenol and 4-ethylguaiacol which are sometimes found in unfiltered aged red wines. Fifty-six Argentinian red wines at various stages of aging were provided for chemical analysis and were tested for sensory defects when the chemical signatures indicated the presence of microbial spoilage. Therefore, the aim of this study was to determine if the wines contained spoilage microbes. Twenty-two of the fifty six wine samples were determined to have spoilage aromas. Two separate Brettanomyces bruxellensis strains were isolated from one of these wines. Wines that are spoiled by microbes may contain viable but not culturable cells making it difficult to provide definitive proof that the spoilage character is the result of the microbes. The two isolates from the Argentinian wines were added to the UC Davis Department of Viticulture and Enology Wine Microbe collection which has one of the most comprehensive collections of Brettanomyces bruxellensis yeast in the world.

A Diet Based on the Dietary Guidelines for Americans (2010) Alters Serum Glycoproteome Profile

Tyler Kim
Sponsor: Sridevi Krishnan, Ph.D.
Nutrition

Metabolic syndrome affects approximately one in five people in the United States. It is characterized by a group of risk factors associated with increased incidence of both type 2 diabetes and cardiovascular disease. Diet is a primary lifestyle factor associated with metabolic syndrome. To promote healthy eating habits, the Dietary Guidelines for Americans (DGA), were created. Studies evaluating the effect of the DGA in controlled trials are limited and as such, several of its impacts remain untested. Following a controlled feeding trial that included 44 women who consumed a diet either based on the DGA 2010 (n=22), or a typical American diet (TAD, n = 22), we evaluated changes in their serum glycoproteome. The glycoproteome encompasses all proteins within an organism that are enzymatically linked with glycans (sugars) to produce glycoproteins. In the current study, alterations of these enzymatically linked glycans, particularly of fucose and sialic acid residues were studied. It is hypothesized that subjects in the DGA group would see changes in glycoproteome that differ from those in the TAD. Non-parametric analyses have thus far revealed that out of the 17 serum proteins evaluated, six showed significantly different glycovariants between the two groups. Further results are anticipated.

Analysis of Polysaccharides in Common Vegetables Using Liquid Chromatography-Mass Spectrometry

Dave Kim
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

Dietary fibers are one of the important macronutrients in our diet, and they are mostly made up of plant polysaccharides. Due to the diversity of polysaccharide structures, accurate analysis of dietary fibers has been lacking. Traditionally, polysaccharides are analyzed through its monosaccharide and linkage composition. In this project, a chemical fingerprinting approach was developed to determine the polysaccharide composition of commonly consumed vegetables, including the parts usually not eaten. This technique constitutes breaking down polysaccharides into smaller oligosaccharides, which can then be used as fingerprinting markers. Oligosaccharide profiles from samples were generated using LC-QTOF and were compared with reference polysaccharide library from commercially available standards. All of carbohydrate samples from selected foods show at least 40% cellulose, except for avocado seed which mostly amylose/amylopectin (68%). Artichoke had compositions with higher amounts of xylans in the outer purple leaf (26%) compared to the inner leaf (13%). Subtle differences were also observed in the polysaccharide profiles between young and mature broccoli samples. As the nutrients we consume affect our general physiological wellness, comprehensive characterization of our diet is essential. This method can be generally applied to analyze the polysaccharide composition of any food material, which can increase our understanding of these macronutrients.

Emotional Regulation in Childhood and Body Mass Index

Julianna Kirkpatrick
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

The association between adult emotion regulation and body mass index (BMI) is well documented. However, less is known about this association in children. By intervening in early childhood, researchers can recommend emotion regulation techniques that can prevent the onset of childhood obesity, thus reducing rates of adolescent and adult obesity. In this study, we aim to fill this gap in the literature by examining emotion regulation strategies in children ages 9-10 years old as they relate to their BMI scores. A total of 182 children and their parents were recruited for our study. Parents completed the validated Emotion Regulation Checklist, which inquires about their child's emotion regulation strategies (e.g., degree of emotional expression, delayed gratification, impulsivity). Height and weight of the child were recorded during the lab visit to calculate BMI. We will test the hypothesis that children who display lower levels of emotion regulation will have higher BMI levels overall—a negative correlational pattern similar to that seen in adults. This study will inform future emotion regulation interventions that would prevent and address childhood obesity.

Investigating the Storage Process of a Nitrocellulose Membrane Following Gel Transfer

Andrew Kisin
Sponsor: Aldrin Gomes, Ph.D.
MED: Physiology & Membrane Biol

Western Blotting is a process by which specific proteins of a tissue sample can be targeted and detected. Consisting of multiple steps including gel electrophoresis, membrane transfer, blocking with 3% milk, antibody incubation, and fluorescent imaging, the Western Blot procedure has the potential to be refined. One point is during the storage process following gel to membrane transfer, in which the membrane can be kept wet with Tris-Buffered Saline, 0.05% Tween 20 Detergent (TBST) or completely dried. Though each of these two methods are vetted by researchers, their effect on the proteins and antibodies has to be studied. In this project, I will run multiple gels and western blots under dry and wet conditions, with antibodies that target varying molecular weights in order to facilitate reproducibility. This will allow me to determine whether there is a difference in signal strength between the two methods, possibly attributed to the presence or loss of protein. Preliminary data suggests that there is a difference, as using the 53kD-specific primary antibody to Desmin and the secondary antibody Goat Anti-Mouse HRP resulted in a higher signal for the wet strips than the dry strips.

The Gikuyu: Values of Women Through Folklore

Aliyah Kleckley
Sponsor: Corrie Decker, Ph.D.
History

Folklore is common throughout various societies and can reveal a lot about a culture's values. The Gikuyu ethnic group from Kenya are no different, as their folklore also gives insight to aspects of their society. By exploring various Gikuyu folklore and primary sources such as journal entries and autobiographies, I am hoping to find the ways in which women functioned in this culture and how this might have conflicted with British colonial influence in Kenya. The goal of my research is to understand how Gikuyu ideals of womanhood compared with women's roles in the family, and behavioral and gender expectations in general. I will examine folklore and oral traditions. I will also compare these values to the ideals taught by imperialist British forces. I want to know if there are any variations within the different clans of the Gikuyu. My goal is to answer the question of how Gikuyu women negotiated with the two different ideals of womanhood.

Secondhand Smoke Impairs Potassium Channel Function in Resistance Arteries

Amanpreet Kler
Sponsor: Madeline Nieves-Cintron, Ph.D.
MED: Pharmacology

Secondhand smoke (SHS) has deleterious vascular effects, then can lead to increased incidence of vascular complications, including stroke and hypertension. The mechanisms linking SHS exposure to vascular complications are poorly understood. Impaired vascular smooth muscle contractility may be a key contributing factor. Vascular smooth muscle contractility is dependent on a dynamic interplay between different ionic conductance that help control membrane potential (excitability) and the level of intracellular calcium ($[Ca^{2+}]_i$). The activity of a number of potassium (K^+) channels regulates vascular smooth muscle membrane potential, which also has a major influence on intracellular Ca^{2+} through the regulation of voltage-gated L-type Ca^{2+} channels. Our experiments show that arteries from mice exposed to SHS have elevated pressure-induced constriction (e.g. myogenic tone). This was correlated with depolarized membrane potential of vascular smooth muscle cells, which in turn was linked to a decrease in the activity of K^+ channels. RT-PCR analysis showed downregulation of calcium-activated potassium (BK) channel alpha subunit, this was consistent lower expression of BK alpha subunit at the plasma membrane of vascular smooth muscle as revealed by proximity ligation assay. Thus, our results suggest that SHS affects vascular smooth muscle contractility by altering the functional expression of K^+ channels.

Getting to the Root of Striga Infection: How Differences in Sorghum Root Structure Affect Striga Parasitism

Anusha Klinder
Sponsor: Siobhan Brady, Ph.D.
Plant Biology

Sorghum bicolor is a cereal and staple crop of sub-Saharan Africa. Striga hermonthica is a parasitic plant that grows into sorghum roots to eventually reach its center-vasculature. Through this mechanism, Striga withdraws water and nutrients from sorghum. Annually, Striga infestation causes a loss of nearly 20% of sorghum yield, resulting in regional economic problems. It is unknown whether the sorghum root structure or developmental stage influences Striga parasitism. Here, we investigate which region of the sorghum root system is more prone to be infected by Striga. We observed more Striga penetrating the sorghum root closer to the root tip, rather than to the root base. We also compared the frequency of Striga penetrations across different types of roots that sorghum develops – main, crown and lateral roots. The type of root did not have an effect on Striga parasitism. Together, these observations suggest that the developmental zone of sorghum root, rather than type of its root determines how easily Striga can infect it.

Gene Expression in Major Inflammatory Pathways in Peripheral Blood Associate with Intracerebral Hemorrhage and Edema Volume in Humans

Bodie Knepp
Sponsor: Boryana Stamova, Ph.D.
MED: Neurology

Primary Intracerebral Hemorrhage (ICH) refers to bleeding in the brain and is a devastating disease with high mortality and morbidity. The size of the hemorrhage is a major determinant of outcome. Peripheral immune response plays a significant role in post-ICH brain damage and repair. Whole-genome RNA expression from 18 ICH subjects was used for Multiple Regression and Weighted Gene Co-Expression Network Analysis (WGCNA). The multiple regression model found 440 genes associated with ICH volume. WGCNA was performed to construct modules of co-expressed genes and identify modules associated with ICH and Edema volumes. It found five modules significantly associated with ICH volume and four associated with Edema volume. Pathway analysis predicted that major inflammatory pathways such as Neuroinflammation Signaling and Inflammasome pathways would be activated with increased ICH volumes. Other pathways predicted to be activated were Leukocyte Extravasation, Thrombin Signaling, and FCγ Receptor-Mediated Phagocytosis. Peroxisome Proliferator-Activated Receptor (PPAR) Signaling was predicted to be suppressed with increased ICH volume. Some research has shown that activation of this pathway may have a neuroprotective effect following ICH. The study suggests major inflammatory pathways in peripheral blood are associated with ICH and Edema volumes and may guide a search for therapeutics.

A Review of the Consequences and Interventions to Manage In-Class Media Multitasking

Michael Kohn
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Technology's capability to provide users with swift access to unlimited information has made it appealing to incorporate technology into the classroom. This has created opportunities for learning, yet also increasing in-class distractions, which educators and students must confront in order to maximize technology as a beneficial learning tool. A literature review of 23 studies was done to examine the consequences of in-class technology use on students' academic performance. We found that 19 of the studies reviewed provide evidence for the negative association between in-class media multitasking and academic performance. Interestingly, the same studies suggest using interventions to mitigate in-class distractions and improve academic performance. Although many interventions have not been experimentally assessed, in 2016 our laboratory conducted a study where technology breaks were assigned during controlled lectures. Our results showed tech breaks were effective at reducing texting during lecture and improving retention of lecture material up to a full letter-grade on average (TBavg = 76.67%; Non-TBavg = 69.07%, $p < 0.05$). Technology breaks are an example of a successful intervention that may be incorporated in the classroom. Finally, we discuss the necessity for further investigation of interventions to mitigate in-class media multitasking and maximize the benefits of in-class technology use.

Adaptive Coloration of the Brooding Sea Anemone *Epiactis prolifera* in Bodega Bay

Manisha Koneru
Sponsor: Eric Sanford, Ph.D.
Evolution & Ecology

Over its geographic range along the coastline of the northeast Pacific, the Brooding Sea Anemone Epiactis prolifera shows colour variation that is discretely distributed between two habitat types - green morphs in eelgrass beds and red, pink and brown morphs on rocky outer coasts. While this variation has been documented in the past, it has not been explained by ecological or evolutionary processes. We hypothesized that colour polymorphism in E. prolifera is the result of selection for background matching to their respective habitats, to escape predation from visual predators. We studied the variation in coloration across two discrete populations in Bodega Bay, CA, using a combination of experimental predator prey trials and field photography. We conducted behavioral predator-prey experiments using the Shag Rug Nudibranch Aeolidia loui and the Mosshead Sculpin Clinocottus globiceps in aquarium tanks designed to resemble the two habitat types. We found that the visual predator, C. globiceps, took significantly less time to find green anemones against the rocky habitat than it did to find green anemones against the eelgrass habitat, suggesting the effectiveness of background matching as a defense strategy against visual predation.

Community Detection: Tuning Parameter of the Bethe-Hessian Matrix

Aravind Krishnachandran
Sponsor: Can Le, Ph.D.
Statistics

Detecting communities within a graph or network of data is an important data analysis method that can be applied to many fields of industry. Spectral clustering is a technique used to cluster the data points within a graph into different communities or clusters based on similar factors and connectedness to other data points. One particular spectral clustering algorithm known as the Bethe-Hessian provides estimates of the number of communities and classification of data points to clusters based on the eigenvalues and eigenvectors of the matrix $H_r = (r^2-1)I_n + D - rA$. The efficiency of this algorithm is influenced by the tuning parameter r. I investigate the ideal r value for various sets of tidy and untidy data, and ultimately analyze the properties of the estimated communities as the r value changes. These properties are analyzed by studying the eigenvalues and eigenvectors of the H_r matrix, along with k-means clustering based on these eigenvectors.

Multi-omics Studies on High Fat Diet-Induced Obese Mice Brain Unveils Altered N-Glycosylation

Miranda Krueger
Sponsor: Mariana Barboza Gardner, Ph.D.
VM: Anat Physio & Cell Biology

Obesity is a major public health problem affecting 30% of the population globally. Obese subjects often show mood disorders and deficits in learning and memory. N-glycosylation is an essential posttranslational modification of proteins required for normal brain development and function, including memory. We hypothesize that abnormal brain N-glycosylation occurs in obesity, affecting cell surface expression and function of key receptors. We performed a glycomic study to evaluate brain glycosylation in a region-specific manner in a well-established mouse model of high fat diet-induced obesity and compared it to control lean mice. N-glycans were released from membrane fractions obtained from brain tissues (cortex, hippocampus and cerebellum) and analyzed by nano-LC-chipQ-ToF Mass Spectrometry. Hippocampal N-glycome showed to be altered in obese mice. Targeted transcriptomic analysis of 32 glyco-related genes that participate in branching and capping complex N-glycans were performed by RT-qPCR. In agreement with our glycomic results, alterations of a branching glycosyltransferase was observed in the hippocampus of HFD-fed obese mice. Together, these results suggest that impaired learning and memory processes controlled by the hippocampus may be due to alterations in its N-glycosylation. Thus, brain glycosylation can serve as a novel target for the development of new interventions to treat obesity-related co-morbidities.

Characterizing Human Specific Segmental Duplications and its Role in the Evolutionary Expansion of the Human Neocortex

Matangi Kumar
Sponsor: Megan Dennis, Ph.D.
MED: Biochem & Molecular Med

Human-specific segmental duplications (HSDs) are regions of the genome that have been duplicated uniquely in the human lineage and are highly similar in sequence. Previous research shows HSD genes impact neuronal migration and proliferation and may influence human neocortex expansion. To test our hypothesis that HSD genes may affect neurodevelopment, we overexpressed HSD gene paralogs in COS7 cells to quantify filopodia outgrowth. We observed significant decrease in filopodia growth for ARHGAP11, GPR89, and FRMPD2 when ancestral and duplicate paralogs were expressed together compared to each paralog individually. We repeated this study in hippocampal mouse neurons and quantified dendritic complexity via Sholl analysis. Preliminary results show ARHGAP11B-expressing cells have lower numbers of primary dendrites (n=4.0) compared to ancestral ARHGAP11A (n=5.7) or control cells (n=7.0; P=0.0056). To understand the impact of neuronal changes on development, we performed in utero electroporation of our HSD genes in mouse embryos to measure neuronal migration in the developing neocortex and saw a decrease in neuronal migration in ARGHAP11B. Overall, though preliminary, the results of this study will inform us on how HSD gene families can impact branching morphogenesis, migration and maturation of neurons in the developing neocortex.

Activity of Oxytocin Neurons in the Bed Nucleus of the Stria Terminalis (BNST) and Paraventricular Nucleus (PVN) and Social Vigilance in Juvenile California Mice

Shreya Kumar
Sponsor: Brian Trainor, Ph.D.
Psychology

Research shows women are more likely than men to develop stress-induced mood disorders, such as social anxiety. We study the neural circuitry underlying anxiogenic behavior and sex differences using a social stress behavior paradigm in a monogamous rodent species, California mice. Previous findings indicate that oxytocin may operate in the bed nucleus of the stria terminalis (BNST) to promote anxiety-like behavior in the form of social vigilance in adult female California mice, but not male California mice. Social vigilance is a risk-assessment behavior in which the animal has a specific head orientation towards an unknown member of its species, but will not approach it. In adults, social stress increases vigilance in females but not males. However, in juvenile mice, social stress increases vigilance in both sexes. The goal of this project is to quantify the activity of cells expressing oxytocin in the BNST and paraventricular nucleus (PVN) in juvenile California mice. We hypothesize that cells expressing oxytocin will be more likely to express a marker of neuronal activity in stressed animals of both sexes. If this hypothesis is supported, it will suggest that adolescent development programs oxytocin neurons to be less responsive to social stress in males than in females.

Detection and Recovery of Shiga Toxin-Producing *E. coli* from Irrigation and Tail Water Collected from Farms in the Salinas Valley

Emma Kurr
Sponsor: Linda Harris, Ph.D.
Anr Food Science & Technology

The ability to safely use irrigation run-off water (or tail water) could be important in the Salinas Valley of California where water conservation is becoming increasingly important. Because of this, there has been an interest in assessing the microbiological quality of tail water. Six tail water reservoirs, located along the Salinas central coast vegetable production area, were sampled monthly for 1 year, using Moore swabs left for 3 days in each reservoir. A total of 26 irrigation water samples and 229 tail water samples was collected and processed by enrichment. DNA was isolated from secondary enrichment and amplified by real-time PCR to detect stx (shiga toxin) genes with a multiplex Taqman assay. To isolate shiga toxin-producing E. coli (STEC), positive samples were processed by immuno-concentration with the mini-VIDAS and plating on CHROMagar STEC. All STEC isolates were then serotyped by PCR. No STEC isolates were retrieved from the two positive irrigation water samples. Among 229 tail water samples, 22 (14%) tested positive for STEC by real-time PCR and isolates were retrieved from 6% (14) of them with a majority coming from one reservoir. The isolates separated into four different serogroups: O26, O103, O111, and O145.

Increasing the Yield of Valuable Coproducts for Microalgae Cultivated on Anaerobically Digested Food Waste Permeate

Serena Kutney
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Oleaginous microalgae produce lipids that can be used as a feedstock for biofuels, reducing society's reliance on non-renewable fossil fuel resources. Inhibitory factors, such as the high cost of cultivation and harvesting, are why microalgae biofuels are not yet a viable alternative energy resource. Cultivating microalgae on anaerobically digested food waste permeate (FWP) has the benefit of remediating the ammonia and nutrient-rich effluent while also producing valuable co-products such as biomass, lipids, and pigments. Cultivating microalgae in salt-stressed environments has been hypothesized to increase the production of lipids by inducing metabolic changes necessary to survive in an extreme environment. In this study, supplementing 10% FWP with various inexpensive chloride salts is being explored as a method to increase lipid content, biomass production, and pigment production of microalgae species, with an overall goal of offsetting the otherwise high production costs. In the process of this research, lipid extraction and quantification procedures have been improved to provide more accurate comparisons between cultivation methods to compare the most effective conditions. Optimizing microalgae growth on FWP will contribute to the body of research focusing on wastewater remediation while also making microalgae products more economically and commercially feasible.

Positivity Bias in Verbal Episodic Memory for Native versus Non-Native Speakers

Michelle Kwong
Sponsor: Beth Ober, Ph.D.
Human Ecology

In prior experiments, our lab investigated potential differences in positivity bias for young-adult native English speakers (E1) vs. non-native speakers (E2). Across three verbal learning and memory experiments, we have obtained a significant language-related positivity effect (i.e., language x valence interaction), due to E2 speakers showing greater memory advantage for positive versus negative English words. In prior studies, each subject was given one long, mixed list of positive and negative words, from several semantic categories. The main purpose of the current study was to determine whether our language-related positivity effect would be replicated with a different type of list-learning paradigm, involving the learning of associations between meaningless symbols and five-word lists. Each "mini-list" was either positive, negative, or neutral, and contained either category co-members or unrelated words. Using this paradigm, we specifically aim to assess E1-E2 differences in: (a) positive versus neutral, as well as negative versus neutral, word recall; (b) modulation of valence effects by categorized versus unrelated word lists; and (c) valence versus category clustering for the overall, delayed, free recall trial. Data collection is ongoing; our poster will showcase preliminary findings.

Influence of Language Environment on an Infant's Vocabulary

Eleanor Lacaze
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

When infants learn language, many factors play a role in how quickly they develop their vocabulary. We are studying what influences how many words an infant is able to understand and/or produce. In the lab, parents fill out measures of their child's vocabulary knowledge, language environment, and demographic information. With this data we can see if the number of words an infant knows is related to how many languages or speakers the child hears on a regular basis and other social factors like socioeconomic status. Studies have shown that hearing variation between speakers' voices is linked to easier synthesis of speech structure in infants (Graf Estes, Lew Williams, 2015). In this analysis, we will compile our data from across 15 studies and over 1000 infants. We predict a positive correlation between monolingual infants' vocabulary size and the number of people they hear speak regularly. For bilinguals, we expect a positive correlation between vocabulary size and the number of people who speak their dominant language (the one they are exposed to for the most hours per week).

Blind Eye: an Interactive Film

Jacob Lacuesta
Sponsor: Timothy Lenoir, Ph.D.
Cinema & Digital Media

Blind Eye is an experimental film in which where it goes and how it ends is absolutely determinant based on your personality. The film follows Aden, a man who pickpockets phones from daily Bay Area Rapid Transit commuters in order to keep him and his family financially afloat. Things take a drastic turn when one day he and his friend, Nat, accidentally steals the phone of a Silicon Valley tech executive — whom by day is plotting a sinister surveillance project and by night is a serial killer. The project is a tangible cultural object meant to display possible cinematic future(s) of hyper-personalization. Not only is this expressed by the existence of the film and the custom-built application it is housed within, but concerns are also expressed within the film as the plot progresses. It is an extension of an initial theoretical paper written in Winter 2019 titled The Cinema of You: An Initial Inquiry on the Micro-Personalization of Cinematic Production and Presentation which discusses the social implications of automated branching narrative films in a time of actualized surveillance capitalism. The film and custom application were developed in tandem as part of an honors project for Cinema and Digital Media.

Weird Wilderness: Transitional Environments in Jeff VanderMeer's *Annihilation*

Aimee Lagrandeur
Sponsor: Margaret Ronda, Ph.D.
English

In his pivotal ecocritical essay, "The Trouble with Wilderness: Or, Getting Back to the Wrong Nature," William Cronon problematizes the canonical Thoreauvian idea of wilderness as an escape by arguing instead that wilderness is not an untouched sanctuary removed from civilization, but rather the two are intertwined. While Ecocritism has used these two ideologies to explore the construction of wilderness, scholarship has neglected the generic effect of less mainstream literary forms such as Weird Fiction, a subgenre of speculative fiction. In my research, I explore how the Weird fiction genre offers an alternative perspective from which to interrogate the dominant ecocritical paradigms, looking specifically at Jeff VanderMeer's Annihilation in contrast to Cheryl Strayed's biography Wild. Both novels begin by looking to nature as a restorative force; however, where Wild understands isolation in wilderness as a way to mediate grief and alienation from society, Annihilation maintains a tension between humans not only empathizing and identifying with nature, but also being alienated from potentially dangerous nonhuman environments. I wish to interrogate Annihilation's construction of wilderness through Timothy Morton's concepts of the hyperobject and superposition, Catherine Malabou's concept of destructive plasticity, and Anna Tsing's concept of the patchy Anthropocene.

Understanding the Impact of Early Season Algae Infestation on Rice Seedling Emergence and Establishment

Guelta Laguerre
Sponsor: Kassim Al-Khatib, Ph.D.
Anr Plant Sciences

Rice production in California has been challenged by the formation of nuisance algae in the beginning of the season. The early formation of algal mats is hypothesized to reduce the rice seedlings establishment. We designed a controlled outdoor experiment to test how the algae infestation level would impact rice seedling emergence and establishment. To simulate different algae infestation level,15-gallon tubs were filled with rice field soil were treated with various amount of fertilizers N: P

including 0:0, 75:35 and 150:70 kg ha^{-1} prior to adding water. Sixty rice seeds (M206) were soaked for 24 hours and spread into tubs. Emerged rice seedlings were counted every second day for five weeks. A Sample of water (50ml) was also collected from each replicates every week for chlorophyll a measurement. A similar pattern of rice seedling emergence was observed across the three experiments. The results showed that the overall rice emergence declined by the increase of the chlorophyll a amount, which means the higher the algae infestation the lower the rice seedling emergence. Our results show that uncontrolled algae could reduce rice stand by up to 90%. Further studies, yet to be done to estimate how much algae could reduce the rice yield.

Investigating the Effects of Semantic Meaning and Visual Saliency on Covert Spatial Attention

Anthony Lagunda
Sponsor: John Henderson, Ph.D.
Psychology

Attention is comprised of two different components: overt attention and covert attention. Covert attention is the attention given to objects on which the eyes are not directly fixated. I focused on whether meaning or saliency is more influential in guiding covert attention. I hypothesized that participants would covertly attend to meaningful locations in scenes while maintaining their overt attention on a fixation cross. Participants (N=30) were asked to maintain their attention on the cross overlaid onto 240 real-world scenes. After a random interval of time, a green onset flashed on the screen, and participants were instructed to press a button as soon as they saw the onset. The onset's location was randomized among 4 conditions: on the most meaningful location in the scene, on a meaningless location, on the most salient location, or on a location with little visual saliency. I found that there was no difference in response times based on whether the onset was on a meaningful location vs a salient location ($p > 0.1$). Similarly, there was no difference in response times between a meaningful/salient location and a location with little meaning/saliency.

Chinese Floral Symbolism in Fashion

Hang Shan Lam
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Symbolic imagery is deeply ingrained in Chinese culture. There is an abundant amount of floral symbolism that pervades both cultural practices and artistic expression. Therefore, it is worth studying how symbolism, more specifically floral symbolism, is applied in Chinese textile arts. Through globalization, the modern world demands fusion between cultures. I study the significance of floral symbolism in Chinese textile arts and crafts through literature review and visual analysis to design a fashion collection. This collection will have four garments in total, where each piece will focus on the representation of seasons with floral symbolism as such the orchid represents spring, the lotus represents summer, the chrysanthemum represents autumn, and plum blossoms represent winter in Chinese culture. The significance of my project is to show how the pieces of a fashion collection are able to change with the seasons promoting the meanings of flower symbolism in the traditional Chinese textiles arts and crafts.

Using Molecular Markers to Characterize Isolates of *B. lactucae* (Lettuce Downy Mildew)

Carrissa Lam
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Bremia lactucae, an oomycete pathogen causing lettuce downy mildew, is a major source of lettuce crop loss. One effective way to control this disease is to grow lettuce varieties resistant to B. lactucae. However, resistance varieties are currently not durable because the pathogen is constantly evolving new ways to overcome resistance. The Michelmore laboratory monitors B. lactucae pathotypes through typing field samples from the Western US for virulence, fungicide resistance, and mating type. This process is time-consuming, resulting in a low number of samples tested. Molecular markers have been developed to more efficiently characterize isolates of B. lactucae. I am using these polymorphic simple sequence repeats (SSRs) to analyze the relatedness of field samples. I am testing multiple samples from each field to see if they were invaded by a single isolate or multiple isolates. I am also optimizing a procedure to efficiently extract DNA directly from B. lactucae lesions so that we can expedite the isolate characterization process. We will use this information to better inform field sampling and testing.

The Effect of pH on Enhanced Silicate Weathering

Jessica Landesman
Sponsor: Benjamin Houlton, Ph.D.
Land Air & Water Resources

In today's environment, carbon emissions are higher than they have ever been and are only increasing. We have reached a critical point in which halting all carbon dioxide emissions is not enough to combat climate change, and thus we must look for solutions to take excess carbon out of the atmosphere. This research project complements a larger research project that analyzes the use of rock amendments on agricultural fields to increase carbon sequestration. Since the pHs of soils are quite variable, it is important to understand how pH may affect rates of silicate weathering. This subset of research looks specifically at the rock amendment metabasalt and the effect that pH has in the process of weathering. Using a soil column experiment, I will measure the amount of bicarbonate in the leachate of columns with silica sand and metabasalt at a pH of 5, 7, and 9. The byproduct, bicarbonate, is used to measure the amount of enhanced silicate weathering that has taken place. The importance of these findings could help determine an ideal pH for agricultural soils in order to maximize the amount of carbon sequestration and thus, aid in reducing emissions that contribute to climate change.

Home Environment and Oral Proficiency: Emerging Bilinguals From Immigrant Families

Frances Lansdowne
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Since the 1950s, research has explored methods to improve English proficiency for dual language learners (DLLs). More research is needed on, however, the factors that influence language development among the various DLL groups, including their language exposure and home experiences. To address the gaps in the literature, this study examined the roles of language exposure, language usage, and home practices on children's bilingual proficiency. A total of 28 DLLs from Mexican-American and 61 DLLs from Chinese-American families were recruited from Head Start centers in Northern California. Parents were interviewed about their child's hourly language exposure, usage, and home literacy practices. Children were assessed on their bilingual proficiency with the Picture Vocabulary, Oral Comprehension, and Understanding Directions subtests of the Woodcock-Johnson Test. Results show no significant difference in the bilingual proficiencies between the two groups. There were differences in the language practices between the two groups. Correlation results show significant relationships between oral proficiency and reading frequency, books in the home, language exposure, language usage, and storytelling in both English and the home language. Results suggest that DLLs from Mexican-American and Chinese-American families have more similarities than differences, and support previous findings that the home environment influences DLLs' bilingual proficiency.

Effects of Texting on Academic Writing

Renee Lau
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

From writing letters to sending text messages, our form of communication has evolved drastically. With the rapid growth of technology this past decade, texting has been more commonly used as a form of communication. Abbreviations like “lol,” “omg,” and many more first originated for the purpose of fitting what you want to say in a limited word count but have evolved into a characteristic of texting. Many parents and teachers despise texting as it uses nonstandard English. However, some researchers argue that texting improves academic writing as people practice writing when they text (Aziz, 2013). My study analyzes how texting affects academic writing by surveying students about their texting uses, English background, and their confidence in English, and interviewing university English professors about their observations on changes in students’ writing performance throughout the decade. I will also examine other studies about texting and academic writing and incorporate their results to explore the pros and cons of texting in terms of academic writing.

Deep Earthquakes in the Mt. Diablo Region, CA

Taryn Lausch
Sponsor: James Mcclain, Ph.D.
Earth And Planetary Sciences

Mt. Diablo, an isolated mountain located in the East Bay Area in Northern California, is part of a complex thrust and right lateral fault system. The area around the mountain is heavily populated and seismically active. Unusually deep earthquakes in the region (greater than ~15km depth) have been observed since the 1980s. There have been no previous studies to map the deep earthquakes and model their locations. This research is aimed at characterizing the locations and correlating them with known Quaternary faults. The study uses Northern California Earthquake Data Center double “differenced data” to locate earthquake events. This approach permits cross referencing locations between multiple earthquakes that are generated by similar faults and occur close together (within a few kilometers). The earthquake events that have occurred since 1980 were modeled using MATLAB. The 3D image produced showed a north-northwest dipping pattern of earthquakes. Using ArcGIS Pro, the data points were overlain on known Quaternary faults mapped by the USGS. The modeling through MATLAB and ArcGIS Pro can provide insight on the prevalence of deep earthquakes in the area, their relation to existing geologic structures, and their possible threat to the region.

Title: Characterization of Defensin Protein Usage by Myxococcales During Development and Hunting

Bryant Law
Sponsor: Mitchell Singer, Ph.D.
Microbiology & Molec Genetics

Myxococcales are unusual amongst prokaryotes for their expression of defensin proteins, which was previously only known to be expressed in Eukaryotes as an antimicrobial. With an incomplete understanding of the role Defensins play in humans, our lab studies the use of defensin in Myxococcales’ development and hunting to extrapolate the usage of the protein for both Myxococcales and humans. Finding characteristic defensin cystine pattern in several Myxococcales, our lab attempted to elicit the function and expression of defensins in M. fulvus B02, M. macrosporus HW-1, and M. xanthus DK1622 based on RNA seq. After filtering data and molecular modeling of hypothetical, orf, putative, uncharacterized, unnamed, defense and defensin characterized proteins from the NCBI non-redundant reference sequence database, we selected four defensin genes. Each gene was examined using knockout mutations via electroporation of the vector plasmid pBJ114 and cloning with E. coli DH5a. We also assessed the usage of defensin as a tool for hunting with P. carotovorum JL1134, P. syringae pathovar alisalensis, S. marcescens ATCC 39006, S. suberifaciens CAI, and X. campestris pathovar vitians BS339.

Modeling Cancer Induction and Development in Cerebral Organoids

Sabrina Lazar
Sponsor: Paul Knoepfler, Ph.D.
MED: Cell Biology & Human Anat

In this project, we will model embryonic cancer induction and development in genetically modified cerebral organoid “minibrains”. Cerebral organoids allow us to study neural development and growth in a three-dimensional way that cells cannot provide. By tracking growth of organoids with pro-cancerous genomes, we will understand the effects of oncogenic gene expression on a developing brain. Delving deeper, we will examine hallmark brain cancer molecular markers and see how they correlate with our organoid model. Most cancers have mutations in specific oncogenes and tumor suppressor genes. We will compare CRISPR-mediated knockout of tumor suppressors in cerebral organoid development against wild-type and control lines. Additionally, we will study the effects of tumor suppressor knockout in human induced pluripotent stem cells and compare their gene expression with their organoid counterparts. We predict abnormal or cancerous growth in tumor suppressor knockout cerebral organoids along with the presence of cancer-associated protein markers. If time allows, we aim to treat cerebral organoids with experimental cancer therapeutics to test their effects on our “glioma in a dish” model. This project will provide information on tumor suppressor mechanisms and fill gaps of data on cerebral organoids as a cutting-edge model for normal neural development.

Countering Illegal Immigration

Nicole Lazo
Sponsor: Jaime Jackson, Ph.D.
Political Science

Immigration and global affairs are two topics that directly affect the US. New foreign policies created to address the topic of illegal immigration are currently needed in relation to the recent rise of undocumented migrants. This research project is focused around what policies are needed to positively effect illegal immigration from the Northern Triangle, specifically El Salvador into the US. El Salvador has a population of 6.4 million and another 2 million Salvadoran immigrants who live in the US. The US has been a safe haven for Salvadorans from civil war, crime, and extreme poverty for decades. There has been a jump in illegal migrants from El Salvador living in the US from 670,000 in 2010 to 750,000 in 2015. El Salvador is the country with the second most illegal migrants residing in the US behind Mexico. Current assistance given to El Salvador by the US is a strategy that includes all seven Central American countries. This assistance from the USAID has not been effective to stop or decrease illegal immigration from these countries. I will explore and propose other ways for the US to assist El Salvador, making it a safe haven.

Secondhand Smoke Mediates Altered Vascular Reactivity

Thanhmai Le
Sponsor: Madeline Nieves-Cintron, Ph.D.
MED: Pharmacology

Secondhand smoke (SHS) has significantly detrimental vascular effects, including enhanced vascular reactivity and hypertension. L-type $Ca_V1.2$ channels (LTCCs) are critical regulators of vascular reactivity, but whether their functional expression is altered after SHS exposure leading to changes in vascular reactivity is unknown. In this study, we hypothesized that vascular reactivity of small diameter mesenteric arteries is altered in mice exposed to SHS, partly due to changes in LTCC function. To test this hypothesis, wild type mice were randomized into control (filter air, FA) and experimental (SHS) groups and exposed to either FA or SHS for 4-, 8-, and 12- week periods. Our data showed a significant increase in vascular reactivity in isolated mesenteric arteries after 12-weeks, but not 4- and 8-weeks, of SHS exposure, compared to FA. This change in vascular tone was correlated with an augmentation in LTCC expression and activity in mesenteric arterial myocytes from 12-weeks SHS exposed mice. These findings suggest a time-dependent link between SHS exposure and enhanced vascular reactivity via a mechanism that promotes LTCC functional expression. The implications of SHS exposure on LTCC function are profound as the increased Ca^{2+} influx could have long-term effects on vascular function via changes in Ca^{2+}-dependent transcriptional regulation.

Post-translational Modifications Prolong Autonomous CaMKIId Activation in Open Conformational State

Leann Le
Sponsor: Julie Bossuyt, D.V.M.,Ph.D.
MED: Pharmacology

Calcium/calmodulin-dependent protein kinase IIδ (CaMKIIδ) regulates numerous functions in cardiomyocytes, including calcium cycling, transcription, and contraction. Autophosphorylation at T287 prolongs CaMKIIδ activity in an open conformational state after Ca/CaM dissociates (autonomous activity), which contributes to various cardiac pathologies, including hypertrophy and heart failure. Recently, several novel post-translational modifications (PTMs), including oxidation at MM281/282, O-GlcNAcylation at S280, and S-nitrosylation at C273 and C290 have been discovered; however, the contribution of PTMs to autonomous activity is still incompletely understood. Here, we mechanistically investigated the extent of autonomous CaMKIIδ activation by these PTMs using our novel FRET-based CaMKIIδ conformational state reporter, Camui (RFP-CaMKIIδ-GFP). In HEK-293 cell lysates, we measured persistent Camui activity by rapidly chelating calcium with BAPTA following activation with saturating levels of Ca (200 μM), CaM (2.5 μM), and PTM substrates (H_2O_2, 10 μM; UDP-GlcNAc, 150 μM; or GSNO, 150 μM) or ATP (1 mM) to facilitate autophosphorylation. Analogous to CaMKIIδ autophosphorylation, all PTM substrate treatments increased the magnitude of persistent Camui activity. These findings provide a mechanistic basis for PTM-dependent regulation of CaMKIIδ in cardiomyocytes and implicate CaMKIIδ activation with a broader range of pathological stressors such as oxidative and nitrosative stresses, and diabetic hyperglycemia.

LGBT+ Youths' Social Media Use for Online Health Information: A Study Using Behavioral Trace Data

Anna Le
Sponsor: Drew Cingel, Ph.D.
Communication

LGBT+ youths face health disparities due to stigma and discrimination and are more likely to suffer from depression and suicidal behaviors (e.g., suicide, suicide attempt) than non-LGBT+ individuals. In addition, LGBT+ youths are more active on social media than non-LGBT+ and utilize the internet as a major source of health information. However, little is known about how LGBT+ youths utilize the internet to seek health information and social support. Most studies that examine the LGBT+ community often rely heavily on self-reports and have low sample sizes as a consequence of the LGBT+ community being a hard to reach population for recruitment and data collection. To address this, our study analyzes digital trace data from a social media platform. Collecting digital trace data allows researchers to understand how people behave online and to recruit inaccessible populations. Therefore, we investigated health-seeking behaviors on a sample of LGBT+ youth sourced from a larger secondary dataset (N = 40,382; ages 12-26) of Trill Project users. In particular, we analyzed LGBT+ users' digital trace data from the Trill Project to understand how this population seeks online support and health information on a social media site.

The Role of Cyclases in *Myxococcus xanthus* Fruiting Body Formation

Kayleen Lederman
Sponsor: Mitchell Singer, Ph.D.
Microbiology & Molec Genetics

Myxococcus xanthus is a gram-negative soil bacterium that is unique in its ability to aggregate into multicellular fruiting bodies when cells sense limited nutrients. In a previous study, it was shown that mrpC, a cyclic nucleotide binding protein, is one essential transcriptional regulator of the M. xanthus developmental cycle. Cyclases are activating enzymes that convert adenosine triphosphate (ATP) and guanosine triphosphate (GTP) into cyclic adenosine monophosphate (cAMP) and cyclic guanosine monophosphate (cGMP), which in turn, activate mrpC. M. xanthus has 13 putative cyclase genes that our lab has shown to be active during aggregation and fruiting body formation. Therefore, I hypothesize that at least one cyclase gene is essential for the initiation of the development cycle in M. xanthus fruiting body formation. To test this hypothesis, I am creating knockout mutations of each cyclase gene in M. xanthus and testing for changes in developmental phenotypes compared to the wildtype. Initial plating of cells on starvation media show smaller fruiting bodies in one of the cyclase mutants when compared to the wildtype, indicating that this cyclase is essential for normal fruiting body formation.

Improving Isobutyl Acetate Production and Tolerance in *Escherichia coli*

Conan Lee
Sponsor: Shota Atsumi, Ph.D.
Chemistry

To transition away from petroleum dependence and its detrimental environmental effects, current research is focused on developing renewable methods to produce high-value chemical commodities. One promising solution is to engineer microorganisms so they can convert abundant, renewable, and inexpensive substrates to desirable products. The model microorganism, Escherichia coli, has been previously modified to produce isobutyl acetate (IBA). IBA is a drop-in biofuel candidate and common solvent used in paints, fragrances, and food flavoring. The toxicity limit of IBA is relatively low, limiting the maximum production and necessitating the use of expensive production techniques. To solve this issue, we used directed evolution to generate a mutant strain with increased production and tolerance, 300% and 50% respectively. The most promising mutations found through whole-genome sequencing are currently being generated individually and in a combinatorial fashion via CRISPR to determine their effect on IBA tolerance and production. This work will both increase our understanding of toxicity mechanisms and improve the industrial feasibility of E. coli IBA production.

Investigating the Effects of the Western Diet on Metal Regulation in the Pathogenesis of Liver Disease

Hannah Lee
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

Non-alcoholic fatty liver disease (NAFLD), characterized by accumulation of fatty acids in the liver, is currently the most common chronic liver disease in Western nations. NAFLD is correlated with elevated consumption of sugars and non-nutritive sweeteners like aspartame, components that are increasing in the Western diet. Interestingly, patients with NAFLD exhibit deficiencies in iron and copper. It is posited that these deficiencies reduce antioxidant defenses thereby increasing oxidative stress, a key factor in disease progression. To investigate the interplay between the Western diet and metal metabolism in NAFLD pathogenesis, we explore how metal biochemistry is affected in human liver cells (HepG2) stimulated with varying sugar and aspartame concentrations. We monitored metal regulatory proteins at both the gene expression and protein levels using real time PCR and Western blots, respectively. By understanding how the Western diet, particularly sugar and aspartame, affects copper and iron homeostasis in vitro, we hope to elucidate the underlying molecular mechanisms that contribute to NAFLD and provide insight into therapeutic and diagnostic approaches.

Development of Fluorescent Marker Lines for Studying Plant Immune Responses to Nematode Infection

Kyle Lee
Sponsor: Shahid Siddique, Ph.D.
Entomology/Nematology

Plant parasitic nematodes are destructive pathogens causing huge losses in crop production. The economic damage is estimated to be $80 billion USD per year internationally, amounting to a 12.3% global crop loss. However, it is not one but several species of nematodes that account for agricultural infection. Various nematode species can infect different plant host tissues, such as flowers, leaves, and stems. Most plant damage is caused by a specific group of root-infecting endoparasitic nematodes. The invasion of roots by these parasitic nematodes causes tissue damage, which prompts plants to induce immune responses. Yet, it has not been fully demonstrated and understood as to whether plant immune activation truly occurs during nematode invasion and whether it holds any significance in host susceptibility to nematodes. In this project, we will generate Arabidopsis marker lines, consisting of promoters that drive a nuclear localization sequence mCherry fusion that is responsive to nematode infection. These lines will be infected with nematodes and evaluated for highly sensitive infection-specific readouts using confocal laser scanning microscopy.

Three-dimension Location of Newborn Hippocampal Neurons of Aged and Young Adult Mice

Julia Lemak
Sponsor: Hwai-jong Cheng, M.D.,Ph.D.
MED: Pathology & Lab Medicine

Adult hippocampal neurogenesis (AHN) has been implicated in age-related cognitive decline and Alzheimer's disease. While significant progress has been made in understanding the role of AHN in the brain, some knowledge gaps still exist in the field. For example, since most previous studies were done in young adult mice, how AHN changes throughout the adult lifetime of the organism is still largely unknown. My project in the Cheng lab is to compare AHN in young adult versus aged mice by investigating where adult-born neurons migrate throughout the three-dimension (3D) space of the hippocampus. To visualize neurons in 3D, we use the ScaleS clearing technique to render the collected opaque tissues clear for imaging. We use fluorescent markers to label a cohort of newborn neurons which began development at a specific timepoint, and then use ScaleS to visualize the exact 3D location of these neurons. Preliminary data showed that newborn neurons were located in clusters in aged mice and were evenly distributed in young adult mice. Further analysis is being done at different developmental timepoints in the growth of newborn neurons for both young adult and aged mice to understand the changes of clustering pattern of adult-born neurons during aging processes.

2018 Migrant Caravan

Anastasie Lenoir
Sponsor: Robert Irwin, Ph.D.
Spanish & Portuguese

The options chosen by Central American migrants after hardline migration policies enacted in 2019 by the United States and Mexican governments is largely unexplored. Social, political and economic conditions in Central America contribute to the migration of people in the region. The fall 2018 migrant caravan claimed global attention, where previously this migration pattern went unseen. This study is conducted through research of online news articles, a video documentary database and current literature on United States/Mexico border relations. Tapachulas, Chiapas is the main center for migrants to obtain legal migration documents. Mexico, due to heavy economic and political pressure from the United States, has delayed processing of documents and denied migrants the legal status to travel between states. Some migrants head north anyway, risking capture and deportation by the Mexican authorities and hoping to apply for asylum once they reach the northern border. At the United States border, migrants are confronted with narrow criteria that qualify migrants for obtaining asylum. The Migrant Protection Protocol/Remain in Mexico program has forced migrants to wait out their often lengthy asylum processes in Mexico. This study focuses on migrant testimonials to understand how migrants are coping with these new obstacles.

Decoding Word Prediction From Alpha-Band Contaminated EEG Oscillations

Kathley Letran
Sponsor: Tamara Swaab, Ph.D.
Psychology

Electrophysiological studies of the N400 have provided deep insights into language comprehension processes. The N400 is a negative polarity event-related potential (ERP)? that is maximal approximately 400ms post-stimulus onset. The N400 amplitude?decreases when words are highly predictable. In this study, participants were asked to?predict?target word? following presentation of a prime word. Relative to unrelated word-pairs (e.g. chair-dog) the amplitude of the N400 is reduced to related word-pairs (e.g. happy-sad). Half of our subjects' data contained alpha-band contamination where the N400 ERP component was not discriminable. Traditionally, these subjects would be discarded, however novel application of machine learning techniques may recover previously unusable data. The goal of this study is to determine whether a machine learning algorithm can distinguish?whether a subject predicted the target word or not?using both alpha-contaminated and clean EEG data. We will adapt Bae and Luck's (2018) decoding analysis method to decode our EEG data using a Support Vector Machine (SVM)-based classification algorithm. We hypothesize that the SVM will decode predicted versus not predicted significantly above chance in alpha-contaminated and clean EEG data. If the algorithm?reliably distinguishes?predicted from unpredicted, our next step will be to apply machine learning to classify semantic information carried post-prime word interval about the target word.

Comparison of Lyophilized and Frozen Tissue for Untargeted Metabolomics Sample Preparation

Rafferty Leung
Sponsor: Oliver Fiehn, Ph.D.
Molecular & Cellular Bio

The metabolome is the complete set of metabolites in an organism. Detection and quantification of metabolites are limited by the stability of metabolites (ability to resist oxidation), extraction solvents, and chromatography. Sample preparation usually entails cutting different sample matrices and then measuring out a standard mass for all samples. This process is time-consuming, increases the time the sample is exposed to exogenous interferences and introduces spatial bias depending on which way the sample is cut (ex. one could cut a liver sample and select more connective tissue if cut in one manner and if cut in a different manner could cut more parenchymal cells). Lyophilization is the process freeze-drying a sample through low-temperature dehydration, ensuring all enzymatic reactions are stopped when samples are thawed. We hypothesize that lyophilization will standardize sample preparation and minimize metabolite degradation, and increase throughput. Here, we present a comparison of lyophilized to frozen tissue for sample preparation.

Effect of Varying Heat Treatments and Aging Under Stress on Thermal and Mechanical Properties of NiTi Shape Memory Alloys

Remy Leutenegger
Sponsor: Rucha Joshi, Ph.D.
Biomedical Engineering

Owing to the superelasticity exhibited by the NiTi shape memory alloy (Nitinol), it is widely used to manufacture medical devices. The mechanical properties of Nitinol such as plateau stresses and ultimate tensile strength and thermal properties such as the transformation temperatures need to be tuned to meet the specifications of a specific device. A sequence of heat treatments known as the aging process can be used to tune the thermal and mechanical properties. We present a statistical model that connects the aging time, temperatures, and stress to the resultant thermal and mechanical properties. The data for the development of this model were obtained by aging experiments, differential scanning calorimetry measurements, and tensile testing. Statistical analysis and modeling were carried out using MATLAB. A demonstration of this model is shown where a suggestion for an aging heat treatment recipe is generated that will furnish the desired set of thermal and mechanical properties for Nitinol.

The Impact of New Student-Run Clinic on the Russian-Speaking Population of Sacramento

Nathan Levinzon
Sponsor: Lucy Shi, M.D.
MED: Int Med Hospitalist

The greater Sacramento area is host to over 30,000 residents who primarily speak Russian, of whom approximately 55% are not fluent in English (Sacramento County LEP). Many may find it difficult navigating the Western medical system. Lack of access to healthcare puts Russian-speaking residents, who live in lower socioeconomic areas, at higher risk of developing preventable chronic diseases (Ainsworth, Dale, et al.). Thus, Nadezhda Clinic has been established to bring the Russian-speaking community of Sacramento culturally sensitive primary healthcare at no cost to the patient. To determine the effectiveness of this project, patients were administered a modified satisfaction questionnaire (PSQ-18) at their first and each subsequent visit. Here, we present a progress report from August 2019 to January 2020 that investigates trends such as Patient Satisfaction, Patient Adherence to Appointments, Clinic Finances and Adherence to Short-Term Goals. The long-term goal of this study is to elucidate how Nadezhda Clinic can best target the gaps in healthcare access in the Russian speaking community residing in Sacramento, CA.

Advancing Equal Educational Opportunity: How California's New Education Financing System is Serving its Disadvantaged Youth

Shoshana Levy
Sponsor: Amber Boydstun, Ph.D.
Political Science

In the United States, there has been a historical gap between the academic performance of advantaged youth and that of disadvantaged youth. Prior research often attributes the successes of White, affluent, and English-speaking students to the abundant resources available for them at home that greatly advance their performance in school. Conversely, minority students, English learners, and low-income students struggle due their disproportionate inaccess to those resources. However, more and more research is being dedicated to the effect of schools and their ability to eliminate these gaps. Therefore, this study assesses specific connection between the funding provided to school districts and the academic performance gaps between advantaged and disadvantaged children. In particular, California's public education system is used to assess how funding allocations to school districts impact the academic performance gaps on standardized exams in English and language arts, math, and English language development. The results offer great insight into how funding alone can greatly impact the education of disadvantaged youth.

Stress and Memory: An Investigation of Pre-encoding Stress and Contextual Changes on Recognition Memory

Kendrick Lewis
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Previous research has shown that experiencing an acute stressor after learning potentiates recognition memory when stress and learning share the same context. To explain this phenomenon, a contextual binding account has been adapted: stress enhances contextual memory, which in turn boosts memory for items within that context. This theory predicts memory enhancements from stress should be present regardless of the stressor's timing, provided they share context. However, this idea has only been tested with post-encoding stress. To test whether contextual binding theory accounts for pre-encoding stress, 52 participants were split into 4 groups based on stress and context conditions. The stress group underwent the Socially Evaluated Cold Pressor Task, while the control group performed a non-stressful equivalent. Participants then either changed contexts or remained in the same context. Afterwards, they encoded 240 negative and neutral images, and were memory tested 48 hours later. Preliminary analyses reveal that pre-encoding stress boosts recollection when context is unchanged. Additionally, stress selectively boosts memory for negative images when context is changed. These results indicate contextual binding theory does not fully account for memory performance when stress occurs before encoding. Future research should involve the fMRI to determine a neural basis for contextual binding theory.

Modeling Algae Productivity for Use in Outer Space

Cherise Lewis
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Due to its abundance and photosynthetic capability, algae produces over half of the oxygen in the Earth's atmosphere. It has been proposed that unicellular microalgae can be used in bioreactors to provide a continuous supply of oxygen in space; however, there are countless factors influencing the productivity and feasibility of this endeavor. To account for all variables and to determine optimal conditions, a group of researchers in a FYS-CURE class compiled existing data from an ongoing literature search and utilized Stella Online modeling software while conducting laboratory trials of algal growth. Students focused on variables including algal species, nutrient types and levels, light types and cycles, temperature, carbon dioxide input, gravitational effects, pH, and the required oxygen output to ascertain an optimal model. Most variables are complex and intricately connected, so the overall goal was focused on making a fully comprehensive online model of the system in order to run trials at different conditions to maximize efficiency. This research is fundamental in the development of feasible long-term space travel, and may also have applications on Earth as a carbon-sequestering system that simultaneously enriches our atmosphere with oxygen.

Production of Polyol Ester Fatty Acid (PEFA) and Triacylglyceride (TAGs) by Oleaginous Yeasts in Agricultural Hydrolysates and Laboratory Media

Yilin Li
Sponsor: Kyria Boundy-Mills, Ph.D.
Food Science & Technology

The aims of the USDA Bioproducts funding program are to convert lignin-rich materials to "high-value, cost-effective, environmentally preferable bio-based products from regionally-appropriate feedstocks,". Oleaginous yeasts accumulate at least 20% intracellular triglycerides by dry weight and can convert substrates such as sugars to intracellular triacylglycerols (TAGs). Biodiesel made from yeast oil would be highly degradable, renewable and sustainable, potentially a drop-in replacement for diesel and compatible to current fuel infrastructure. Three oleaginous yeast strains from the Phaff Yeast Culture Collection were discovered to accumulate intracellular TAGs and also secrete glycolipids called polyol esters of fatty acid (PEFA) was discovered when grown in two types of agricultural hydrolysates and thirteen types of laboratory media for about 5-7 days at a pH of 5.5. PEFA accumulation in laboratory media was visually observed and identified by thin-layer chromatography (TLC), no PEFA was identified from almond shell hydrolysates. TAGs accumulated by yeasts ranged from 1.8 to 5.3 g/L; 2.4 to 3.5 g/L; and 1 to 1.2 g/L for USDFST 16-6246 and 81-84 grown in Medium A with glucose, Medium A with p-Hydroxybenzoic acid (pHBA), and Medium A with vanillic acid, respectively. PEFA droplets were consistently detected when the C:N ratio of laboratory media was 60.

A Transposable Element Interrupts Gene Regulation and Haustorium Development in the Root Parasitic Plant *Triphysaria versicolor*

Jingyanshan Li
Sponsor: John Yoder, Ph.D.
Plant Sciences

Root parasitic plants in the family Orobanchaceae can be devastating agricultural weeds. Triphysaria versicolor is used as a model parasite for this family, because it is non-weedy, native to the Pacific Coast, and amenable to molecular genetic studies. Parasitic plants use an organ known as a haustorium to attach, invade, and acquire resources from host plants. Previous research has shown the T. versicolor gene Quinone Reductase 1 (TvQR1) is transcriptionally upregulated early during haustorium formation. While there is only one TvQR1 gene, we have identified at least three distinct promoter alleles. One promoter allele contains a Miniature Inverted-repeat Transposable Element (MITE) near the start of the gene. Our preliminary results show that plants with the MITE containing allele are deficient in the upregulation of TvQR1 and form less haustoria. This research contributes to our fundamental understanding of haustorium development in Orobanchaceae, and will lead to future strategies to combat parasitic weeds.

Shoes that Last: a Sustainable Approach to Growing

Zhaoran Li
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Children's bodies grow rapidly during their first few years, which results in high consumption of children's clothing. In particular, children's shoes might only be used a few times before needing to be replaced. It is estimated that children, in general, grow out of their shoe sizes at least 3-4 times a year. This rapid shoe consumption contributes to waste and can also be a financial burden for families with young children. Based on the results from user interviews and secondary research on existing products, we propose to design a children's shoe that can accommodate foot growth across multiple shoe sizes. To do this, we will incorporate a number of recent innovations in functional apparel, such as expandable knits, experimental closures, waterproof finishes, and flexible soles to arrive at a prototype that is comfortable, functional, and long-lasting. With this project, our design can lead to more sustainable products that incorporate innovative materials and construction techniques for transformable wearable design applications.

Monosaccharide Composition and Glycosidic Linkage Analysis in Tea Using UHPLC-QqQ-MS

Yajing Li
Sponsor: Carlito Lebrilla, Ph.D.
Chemistry

The total tea consumption of the world is 3,000,000 tons a year. Tea has proven to have health benefits such as decreasing the risks of cancer, diabetes, heart attack, and various other diseases. These benefits have largely been attributed to the polyphenolic and phytochemical content of tea. However, a large component of tea is made up of carbohydrates, an area that has largely been overlooked. In the present study, the carbohydrates in 14 teas derived from Camellia Sinensis and 6 different herbal teas were subjected to both quantitative monosaccharide compositional analysis and glycosidic linkage analysis. Monosaccharide analysis was performed by subjecting the homogenized samples to a pectinase treatment followed by hydrolysis with trifluoroacetic acid. The resulting monosaccharides were derivatized with 1-phenyl-3-methyl-pyrazolone (PMP) and quantitated using UHPLC-QqQ-MS, operated in dMRM mode. Glycosidic linkage analysis was performed by permethylating samples with sodium hydroxide and iodomethane in DMSO before acid hydrolysis and derivatization with PMP. The methylated glycosides were then analyzed using UHPLC-QqQ-MS in MRM mode. Determining the carbohydrate composition of tea will allow us to understand how these structures affect health outcomes. This information can help lead us toward better prebiotics and better dietary interventions.

Targeted Meiotic Recombination in *Arabidopsis thaliana*

Emily Lieu
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Climate change will have major detrimental effects on agriculture. Breeders can introduce traits for climate change resilience into crops by crossing them with wild relatives and selecting progeny with the desired traits. However, this can be difficult if the underlying genes are located on the same chromosome. Reshuffling of these “linked” traits depend on meiotic crossovers to recombine alleles between the parental chromosomes during meiosis, which does not happen uniformly along chromosomes. We are using the model plant Arabidopsis thaliana to test whether we can direct crossovers to a specific location on a chromosome, which is expected to facilitate the generation of desired trait combinations. We are constructing plasmids expressing a guide RNA and a nuclease-dead Cas9 (dCas9) fused to a crossover enhancer protein. We expect that transforming these plasmids into the A. thaliana genome will increase the frequency of meiotic recombination at the guide RNA target location. We will cross the transformed plants to fluorescent reporter lines of A. thaliana which can detect whether a crossover has occurred. Currently, the constructs we have made differ in crossover enhancers and promoters. We are waiting to obtain transformed plants for crosses to the reporter lines while we prepare new constructs.

The Business Behind the Cages: *Why and How the United States Profits from*

the Central American Migration Crisis

Trishia Claudin Lim
Sponsor: Jeannette Money, Ph.D.
Political Science

This paper traces decades of U.S. involvement to provide peace and security in the Northern Triangle of Central America (NTCA), which refers to countries of Guatemala, Honduras, and El Salvador. However, attempts to curb immigration from this region has led to many consequences that often leaves people, especially those who are seeking asylum and refugee status, to almost no access for legalization in the United States. As a consequence of poorly written policies regarding the rise of the population, immigration facilities are needed to hold the millions of those detained. The purpose of this historical context is to present the series of sequential steps that has led to the emergence of a lucrative industry: for-profit deportation and detention facilities. The paper points to Geo Group, the largest private corporation operating alongside with Immigration and Customs Enforcement (ICE) to examine how past and current U.S. immigration policies have enabled them to profit off of detained migrants.

Testing Learning and Pro-Social Motivation in the *Ube3a* Deletion Rat Model of Angelman Syndrome

Ruona Lin
Sponsor: Jill Silverman, Ph.D.
MED: Psychiatry & Behav Sci

Angelman Syndrome (AS) is a rare neurodevelopmental disorder caused by the loss of function in the maternal copy of the UBE3A gene. Individuals with AS display developmental delay, intellectual disability, as well as impaired communication. These behaviors are now open to investigation in a rat model of AS in which the Ube3a gene has been deleted. We performed, for the first time, a test of pro-social motivation which tasked Ube3a deletion rats with learning to maneuver the door of a restrainer in order to release a trapped conspecific. While this task typically involves trapping the subject’s cagemate inside the restrainer, we sought to test rats’ motivation to open the door for a trapped stranger rat. Our results revealed that both wildtype and Ube3a deletion rats were pro-socially motivated to release a stranger conspecific and that Ube3a deletion rats were able to learn the task within the ten test sessions at a pace comparable to wildtypes. This was true both when the trapped conspecific was a novel wildtype and a novel Ube3a deletion rat. Since rats use ultrasonic vocalizations to communicate both negative and positive affect, analyses are ongoing to investigate the potential role of these vocalizations in the task.

Fatty Acids Differentially Regulate Collagen Synthesis and Function of In-vitro Engineered Anterior Cruciate Ligaments

Ryan Lin
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Fish oils are the most popular natural supplement consumed in the United States due to their purported benefits: decreasing heart disease, macular degeneration, depression, and rheumatoid arthritis, among others. Previous research suggested that fish oils increase collagen, the main protein of ligaments. This study examined the effect of omega-3 fatty acids on in-vitro engineered human anterior cruciate ligament (ACL) constructs. Cultured ACL cells were embedded into a fibrin gel, engineered into ligaments between calcium brushite anchors, and subsequently treated with either bovine serum albumin (BSA) control, low-dose Eicosapentaenoic acid (EPA, 20:5(n-3)), high-dose EPA, or palmitic acid (PA, 16:0) for 7 days with refeeding every other day. EPA had no significant effect on the collagen content or mechanical and material properties of the ligament constructs compared to control. High-dose EPA tended to increase mechanics and collagen; however, there was no significant difference between these two groups. PA treatment significantly decreases ligament mechanics and collagen content compared to all other groups. These results suggest that different fatty acids shift collagen synthesis and mechanics in divergent ways: EPA slightly improving and PA significantly decreasing ligament structure/function. Further research is needed to determine the mechanism underlying the effect of PA on ligaments.

Using UV Spectroscopy to Evaluate the Efficiency of R848 Attached to Fe_2O_3 to be Encapsulated Into HEVNP

Hao Lin
Sponsor: R holland Cheng, Ph.D.
Molecular & Cellular Bio

Toll-like receptors (TLRs) play an important role in recognizing pathogen-related molecules and controlling immune cell regulation. TLR 7/8 has been an important target that can be recognized by several small molecule drugs such as Resiquimod (R848), resulting in effective immune responses. R848, an immune agonist that can potentially function as cancer immunotherapeutic, is limited in clinical capacity because of the systemic side effects. Thus, a better drug delivery system is needed to localize the drugs to the tumor cells. Our approach is focused on attaching R848 to Ferrite nanoparticles through simple dissolution in the background of 1% DMSO PBS buffer. Subsequently, the Ferrite-R848 complex is encapsulated into Hepatitis E viral nanoparticles (HEVNP) for targeted delivery. The efficiency of R848 delivery is evaluated through in vitro and UV spectrometry. Using UV spectroscopy will provide a novel protocol to quantify the efficiency of R848 attached to Ferrite nanoparticles to be encapsulated into HEVNP.

Modulating the Metabolism of Cell Free Protein Synthesis Systems to Increase Yield

Hamad Linjawi
Sponsor: Cheemeng Tan, Ph.D.
Biomedical Engineering

Cell free systems have emerged as a powerful platform for the production and study of proteins and cellular reactions in a controlled molecular environment. Cell free systems are created by extracting the protein generating machinery of cells, and utilizing this cell extract to produce proteins and express gene networks under defined conditions. One of the major limitations of cell free systems is the limited protein yield of these systems. Many factors have been identified as having detrimental effects on cell free protein production capacity. One such factor is the accumulation of reaction byproducts, such as inorganic phosphate, which become toxic at high concentrations in the cell extract. Solutions to this problem of inorganic phosphate accumulation have been investigated, but none have yet met the scalability and reducibility needs of the field. Our alternative approach enriches the bacterial cells native metabolism with an enzyme that recycles inorganic phosphates into useful glycolytic metabolites through genetic modification. Our overexpression system provides a cheap and reproducible method to increase the longevity and yield of cell free systems. This increase in expression efficiency opens the door for cell free expression of more complex and energy taxing gene networks and proteins.

Life Cycle Reversal Potential in Moon Jellyfish

Jacob Lipovac
Sponsor: David Gold, Ph.D.
Earth And Planetary Sciences

The moon jellyfish exhibits a complex life cycle where stationary polyps metamorphosize into free-swimming medusae. Preliminary evidence suggests that *Aurelia* might be capable of performing life cycle reversal that allows it to revert back to the polyp stage directly from the medusa. However, the environmental conditions under which this process occurs are still unclear. The purpose of this study is to validate life cycle reversal in the moon jellyfish *Aurelia* and determine which tissues drive this process. In this study, the medusa body will be divided into several pieces representing the major tissue structures. These pieces will then be collected in a tank and exposed to physical stress through starvation. Successful formation of polyp colonies from the degrading medusa could lead to the classification of *Aurelia* as a biologically immortal species, making it a valuable model for investigating fundamental processes in the biology of aging. This characteristic could also result in an increased interest in genes and cell processes that aid in reverse aging and carry pharmaceutical applications.

Alternative Social Control: Incarceration and Public Assistance Spending in the State of California, 1995-2015

Max Lisch
Sponsor: Timm Grattet, Ph.D.
Sociology

Jails and prisons exist in an ecosystem of state programs that interact and influence each other. In order to understand the role of incarceration in society, it is necessary to consider welfare as one of these interactions. Public assistance represents an alternative form of state control that is important for understanding the utilization of jails and prisons. Despite this connection, previous studies have been limited in their exploration of the relationship. I utilize California county data from 1995-2015 to construct a regression model to compare the utilization of welfare spending and the incarceration rate over time. Results suggest that there is a significant positive relationship between incarceration and welfare. I argue that this relationship is the combined effects of collateral consequences and a shift in policy towards the diversification of state control mechanisms. Incarceration produces additional welfare needs through the collateral consequences of parental incarceration. The allocation of funds to country assistance programs allows the realization of these needs through county welfare spending. The potential implications of this research include concrete policy choices about funding allocation, and theoretical implications that further the sociological understanding of the role of different forms of state control.

Investigating Social Dominance Hierarchies in Group-housed Gestating Sows

Joshua Liu
Sponsor: Kristina Horback, Ph.D.
Animal Science

Female swine that are housed in groups develop social hierarchies through acts of direct and indirect aggression. Social ranking, which can be inferred by displacement at feeding and non-feeding times, has been reported to be correlated with production characteristics, such as weight gain, and animal welfare indicators, such as skin lesions. Paired feeding competitions, which have been used to establish social ranking in previous studies, have yet to be validated as a reliable method to assess social rank in group-housed gestating sows. This poses an issue because the results of these competitions could reflect other motivations rather than dominance rank. To determine if the dominance relationships in pairwise experiments reflects the true hierarchies in group pens, we will conduct feeding competition tests, observe pen behavior, and collect physical measurements (weight, lesion scoring, body condition, etc.). These measurements will be used to account for extraneous factors which could affect a sow's performance in the feed competition tests, as well evaluate the relationship between social rank and animal welfare. An enhanced understanding of how to assess social rank among group-housed gestating sows may help producers to improve animal welfare and maintain ideal production characteristics and nutrition by customizing their housing groups.

Quantitative Investigation of Arrhythmogenic Mechanisms in the Failing Rabbit Ventricular Myocyte

Caroline Liu
Sponsor: Eleonora Grandi, Ph.D.
MED: Pharmacology

Derangement of subcellular signaling pathways that regulate excitation-contraction coupling in ventricular myocytes is associated with increased propensity for arrhythmia in heart failure (HF) patients. Ca/calmodulin-dependent protein kinase II (CaMKII) hyperactivation in HF leads to excessive intracellular Ca loading and signaling, thereby promoting Ca-dependent arrhythmias. Pathologic Na accumulation, intrinsic to HF and also partially due to CaMKII-dependent phosphorylation of Na channels, further contributes to Ca overload and increased CaMKII activity. Here, we aimed at quantitatively characterizing the network integrating Na, Ca and CaMKII signaling pathways, and investigating how their crosstalk promotes arrhythmias. We performed a computational analysis using a novel mathematical model of the rabbit ventricular myocyte that integrates the electrophysiological changes experimentally observed in an established animal model of HF. Our simulations confirm the existence of an arrhythmogenic positive feedback loop linking Na, Ca, and CaMKII, which can be exacerbated by CaMKII hyperactivation in HF and concomitant ß-adrenergic stimulation. This analysis may inform new therapeutic approaches against arrhythmias in HF patients by targeting any of the nodes involved in the signaling network.

Sinking Our Teeth Into Data Deficiency In Sharks

John Liu
Sponsor: Damien Caillaud, Ph.D.
Anthropology

Sharks demonstrate a tremendous amount of life history diversity among taxa, and play a prominent role in ecosystems worldwide. Yet according to the most recent classification of the IUCN (April, 2019), 15.5% of shark species are threatened with extinction. Notably, however, 39.6% of all known shark species are data deficient, with insufficient information available to properly classify their conservation status. Without basic knowledge of the population dynamics and life history of these species, it can be difficult to determine the ecological roles they may possess in their respective ecosystems and subsequently enact any necessary protective measures. In this study, we review existing empirical studies to determine common features of data deficient shark species, which may be used to better direct research efforts of particular species and/or oceanic regions. We hypothesize that factors including size, habitat type, reproductive strategy, economic value, and fishing interest may limit our ability to properly assess the population status of data deficient species. Combined with future empirical work and a more in-depth analysis of each of the identified causal factors, results from this study can be used to develop a framework for improved species data collection and conservation status classification.

Assessing the Relationship Between the Emotional State of Dogs and Their Human Handlers – a Pilot Study

Serene Liu
Sponsor: Lynette Hart, Ph.D.
VM: Population Hlth & Reprod

Unresolved chronic stress in animal shelter workers could be detrimental to the welfare of animals and increase the risk of injury for shelter handlers. This study evaluated the emotional states of dogs and their human handlers during routine handling and investigated if the completion of a stress-reduction exercise prior to dog handling could decrease stress levels in both handlers and dogs. The stress levels of 40 human handlers and dogs were assessed by observing stress behaviors during routine handling. Handlers and dogs participated in two sessions, one of which was preceded by a stress-reduction exercise. Each session was recorded and consisted of two sets of identical handling exercises and a third set during which the handler was verbally given a stressor. The frequency of stress-related behaviors, measured through video recording observation, will be compared using a mixed Poisson model. If our hypotheses that there is a relationship between handler and dog emotional states and that a stress-reduction exercise will decrease handler stress are proven correct, the results of this study could have implications for shelter dog welfare.

Tissue Geometry is Critical for the Formation of Arrhythmogenic Early afterdepolarizations

Yifan Liu
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

When the heart is beating, the electrical action potential waves propagate periodically in tissue. Normally, the wave propagates smoothly without interruptions. However, under pathological conditions, the propagation can be disturbed and may form spiral waves or spatiotemporal chaos. In this study, we investigated how tissue geometry affects action potential wave propagation using physiologically detailed computer models. Action potential waves can propagate only when there are enough source cells to excite neighboring cells. Therefore, propagation from a small region to a large region is more difficult than the other way around. This phenomenon is called “source-sink mismatch”. We found that the source-sink mismatch can promote the formation of arrhythmogenic early afterdepolarizations (EADs). We varied geometry and model parameters and identified arrhythmogenic regions in the parameter space. We found that this phenomenon happens only when the source-sink mismatch is intermediate. If the source-sink mismatch is too small, the action potential wave propagates normally with a small delay. In the contradict, the action potential wave cannot propagate. We also found that the gap junction conductance and shape of the action potential are also critical for the formation of EADs. This study will shed light on the role of tissue geometry in cardiac arrhythmias.

Identify Homozygous UBR7 T-DNA Insertion Knockout Lines in Arabidopsis thaliana

Jau-Yi Liu
Sponsor: Savithramma Dinesh-Kumar, Ph.D.
Plant Biology

Nucleotide-binding leucine-rich repeat (NRL) class of immune receptors are important in plant immunity. Nicotiana benthamiana that expresses N NLR protein is resistant to Tobacco mosaic virus (TMV). In our previous study, we identified an NRL interacting protein, UBR7, in N. benthamiana using TurboID-based proximity labeling approach. UBR7, a putative E3 ubiquitin ligase, associates with N protein to form an unstable N-UBR7 complex in the absence of TMV. During TMV infection, p50 helicase domain protein of TMV associates with UBR7 and releases it from N-UBR7 complex. With the absence of UBR7, N protein stabilizes and activates the hypersensitive response. Hypersensitive response causes cell death at the infection sites and inhibits TMV cell to cell movement. To investigate whether UBR7 functions similarly in Arabidopsis thaliana, we will identify T-DNA insertion knockout lines and charaterize them for their response to pathogen infection. I will present my approch and data on screening and identification of homozygous UBR7 insertion lines in Arabidopsis.

The Role of miR156 in Leaf Development in Legumes

Audrey Loaiza
Sponsor: Neelima Sinha, Ph.D.
Plant Biology

In maize and Arabidopsis, the microRNA miR156 controls the transition between the juvenile and adult phases of development, where high levels of miR156 promotes juvenile traits and low levels permit adult traits. My project will examine what traits are controlled by this microRNA in the genus Acacia. In particular, juvenile and adult leaves in Acacia are known for their distinct morphological adaptations to the unique environmental differences experienced during their life history. Using plant tissue culture and transformation techniques, I will transform Acacia crassicarpa leaf tissue with Agrobacterium containing constructs that over and under express miR156. Transgenic plants will be created using a protocol that induces regeneration, shoot induction, shoot elongation, and root induction. Plants will be confirmed for transgene insertion using PCR and will be acclimated to the environment by transferring them to soil. Using these plants, I will examine which leaf traits are regulated by miR156. The expected phenotypes are compound, juvenile leaves in those with overexpression of the gene and simple, adult leaves in those with under expression of the gene. These findings will determine what role miR156 plays in leaf development in Acacia crassicarpa and given insight into the evolution of leaf morphology within the Acacia.

ERP Decoding of Low-and-High-Contrast Orientations: Implications for Awareness of Low Level Sensory Representations

Alyse Lodigiani
Sponsor: Steven Luck, Ph.D.
Psychology

Neurons in early visual areas depend on contrast to respond, however, we can consciously perceive stimuli at low contrast. To test the hypothesis that the precision of these high-level representations remains relatively constant at low levels of contrast, we conducted two experiments. This knowledge fills a gap in the literature about visual processing and awareness. First, we conducted a behavioral study to show that, at low contrast, people could have a representation of an oriented-teardrop-shape, which was presented as one of three dark stimuli of varying contrasts on a grey background. Next, we conducted an Event Related Potential (ERP) decoding experiment where we examined the ability to decode the orientation of the stimulus from the scalp distribution of the ERP at each moment in time following the onset of the stimulus. Results were consistent with our hypothesis, showing that during the early sensory period (~50-150ms) decoding accuracy was higher for high contrast than low contrast. By 200ms, decoding accuracy was equally high for low contrast as for high contrast. These findings suggest that early visual areas are not encoding the conscious perception of orientation, but awareness instead requires iterative processing over time to extract a contrast independent perception of orientation.

Exploring Differences in Working Memory as a Predictor of Eye Movement Behavior

Zoe Loh
Sponsor: John Henderson, Ph.D.
Psychology

This study is an attempt to replicate the results of a recent study (Luke, Darowski, & Gale, 2018), which found a significant relationship between eye movement and working memory. Replication is important in psychology as it strengthens the validity of previous findings. Specifically, we tried to replicate findings that showed longer fixation times (tau) are significantly correlated with lower working memory scores. We had 100 healthy UC Davis student participants perform two scene viewing tasks, aesthetic judgement and memorization. We also measured working memory using an operation span task. We replicated their analysis methods to find maximum likelihood estimates for the mean (mu) and tau for each participant's averaged fixation duration. Participants in our study had similar fitted means in fixation duration in the two scene viewing tasks, aesthetic judgement (M= 160, SD= 21) and memorization (M= 150, SD= 21) as the Luke et al. paper (M= 167, SD= 20). However, we were unable to replicate their results, as results from our mixed-effects linear model found no significant relationship between tau and working memory performance for either task. This replication attempt shows that more work needs to be done in examining this relationship.

The Role of Socioeconomic Status and Childhood Stress on Memory and Hippocampal Development

Melissa Loomis
Sponsor: Simona Ghetti, Ph.D.
Psychology

Childhood environmental factors such as stress and socioeconomic status (SES) have been linked to changes in brain development and performance on cognitive tasks. Previous research has shown that higher SES is associated with better memory performance in middle childhood. In addition, pubertal hormone levels have been linked to cognitive sex differences. We collected memory performance on a variety of tasks, questionnaires assessing environmental variables, and structural MRI scans from children aged 7-15 across three time points (T1: N=155, T2: N=122, T3: N=92). We found that stress, measured as number of stressful life events, showed a sexually dimorphic pattern, with greater stress in females correlating with lower memory performance over time, and greater stress in males correlating with greater memory performance over time. We predict that this pattern is related to differing testosterone levels during puberty. Additionally, we found that one measure of SES, mother's education, was positively correlated with memory performance. Our current study hypothesizes that lower SES, measured as a combination of parental income and education, is correlated with lower memory performance and smaller hippocampal volumes. This study will help elucidate the factors that underlie the lasting disparities arising from childhood differences in stress and SES.

Impact of Emerging Artificial Intelligence (AI) in Human Resource (HR) Industry, (Qualitative Interviews & Online Content Analysis)

Marcelo Lopez
Sponsor: David Kyle, Ph.D.
Sociology

As the use of AI powered technology grows within the recruitment/human resources industry it impacts business utility & culture. The recruitment market is vast with major influence over company cultures, industry standards, & hiring policies. As reflected in its monetary value; an estimated worth of $554 billion annually according to the most recent report from the WEC. In recent years Google, LinkedIn, & Facebook have entered the recruitment industry with big plans & major investments. Published in 2016, El Ouirdi's research into the organizational adoption of technologies falls short of addressing the issues regarding institutional bias. Up to now, most research conducted in this topic, of how companies use AI powered tech in recruitment has been limited to 'efficiency' based topics, as well as conducted with a human capital investment-based lens. By applying the theory of institutional bias, my research attempts to uncover the impact & implications underlying the use of these technologies within the workplace. Moving away from quantitative based survey research, I explore the same topic with a more qualitative approach. Using interviews and on-line analysis of HR sites his allows me to get at the core of how hiring managers & companies are utilizing, understanding, & applying these technologies.

Tijuana Entre la Historia y el Mito: La Ciudad Fronteriza y Sus Multiples Interpretaciones

Salvador Lopez
Sponsor: Robert Irwin, Ph.D.
Spanish & Portuguese

This study examines the representation of the city of Tijuana in the literature of three US writers: Richard Brautigan, Zachary Karabashliev and Erik Orrantia, and of five local writers: Federico Campbell, Luis Humberto Crosthwaite, Rosina Conde, Heriberto Yépez and Mayra Luna. I discuss how the writings, especially those of the latter writers, resist interpretations, from both the US and Mexico, that are used to explain the city's sociocultural reasoning: Tijuana as a capital of sin, as a tourist city, as a threat to the "national identity," or as the stereotypical illustration of a process of cultural hybridity that goes beyond previous ideas of class, nation, and identity. I argue that these writers present Tijuana as an inner point of reference for themselves as writers and also as individual beings. Within these structures, not only do these writers reveal the way in which the dominant descriptions of Tijuana are formed and carved in the collective imagination; they also lead us to consider the city's inner sociopolitical and economic borders, and the conflicting coexistence to which they give rise. I also argue that their works are important because they prevent us from oversimplifying border identities and border literature.

Documenting the Undocumented High School Student Perception of Depression and Mental Health.

Enrique Lopez
Sponsor: Caitlin Patler, Ph.D.
Sociology

Stigma has been placed upon the mental health of undocumented individuals. Such stigmas originate from cultural, political and sociological structures surrounding the migrant community and the lack of culturally sensitive safe settings. This stigmatization has darkened the awareness and acceptance of mental health issues among the undocumented community, leaving them largely unexplored. The suppression and unawareness of such feelings can lead to significant mental health issues on individuals of any age. In this research, I attempt to better understand the perception undocumented high school students have towards depression and mental health. Methods used for this study will include the recollection of oral stories through focus groups, and interviews, with undocumented students at Berkeley High School. I aim to find commonalities and deviances on these perceptions. I intend to discuss topics regarding the project with field expects, school administration and teachers, with the goal of gaining a more holistic perspective. The objective is to obtain a clearer outline of communal perceptions of mental health, and how it affects the students' environment and outlook. While solutions to these problems are nuanced and often times individual-specific, this project aims to provide the groundwork to better understand the lived experiences of these students.

Using Passive Eye Tracking to Measure Language Comprehension in Autism

Graciela Lopez
Sponsor: Susan Rivera, Ph.D.
Psychology

The "Looking while Listening Task" (LLT) is a passive eye-tracking paradigm used to index language comprehension. Participants are shown images depicting two nouns, one of which is named. Given research suggesting differences in motor function and social attention in Autism Spectrum Development (ASD), the LLT's passive approach may have particular value in ASD. The present study investigates the convergent validity of LLT in ASD and Typical Development (TD) through comparison with established language measures, the PPVT-4 and CDI. Data were collected from 28 ASD (mean age = 38.40 months) and 11 TD (mean age = 34.72 months) participants. There were robust positive correlations between LLT visual preference to the named target and PPVT scores, $r(15) = .72$, $p = .001$, and between LLT visual preference and parent-reported word knowledge on the CDI, $r(25) = .65$, $p = .0001$. However, visual preference did not differ between words known and unknown to ASD individuals per parent-report, $t(8) = -0.35$, $p = 0.74$. The convergence between LLT and traditional language assessments supports the validity of LLT, but the lack of convergence with parent reports of knowledge of individual words emphasizes the complexity of the challenges surrounding measurement of language in ASD.

Oral Retellings in Spanish and English: An Exploratory Study with DLLs in Kindergarten

Darlyng Lopez
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Recent research on the language and literacy development of Dual Language Learners (DLLs) has used standardized measures to document language skills. However, although research suggests that oral retelling may provide better insights into DLLs' oral comprehension and proficiency than standardized measures, many studies have not examined the oral retelling skills of DLLs in both home language and English. In this exploratory study, we gathered narratives of Spanish-English DLLs who were enrolled in a dual language immersion program. A total of 11 DLL kindergarteners were asked to listen to "Frog Where are You" in English and "Frog Goes to Dinner" in Spanish while looking at the pictures in the book, and asked to retell the story in the respective languages on two separate days. Data was collected at the beginning of the school year and again at the end of the first semester. Narratives were coded for structure and calculated for the total number of words and number of different words. Results show that overall children performed better in English than Spanish on both pre- and post-tests on the oral retellings. Results suggest that more focus on the retention of the Spanish language is needed to maintain the DLLs' home language.

Effects of Drug Powder Composition on Dry Powder Insufflation (DPI) Device Delivery

Alexandro Lopez
Sponsor: Jean-pierre Delplanque, Ph.D.
Graduate Division

Mallard ducks are susceptible to Aspergillus fumigatus, a common fungal infection that manifests in the wild duck population. During wildlife rehabilitation efforts, mallard ducks are prophylactically treated with Amphotericin B, a common antifungal medication. Our lab group —the Delplanque Research Group— has designed a dry powder insufflation (DPI) device to deliver this medication directly into the avian trachea and to the affected lungs. However, our device has experienced difficulties in delivering the medication uniformly to the lung, partly due to hygroscopicity of the drug powder. To address the issue, we hypothesize that varying the composition of the drug by adding a diluent powder will reduce agglomeration, and thereby improve drug distribution. Drug composition will be mixed at several ratios ranging from 1:0 to 0:1 (drug to diluent and vice versa). The drug mixture will then be tested with the DPI device in-silico using a 3D printed avian trachea model to assess whether distribution improved. Preliminary results show that the hygroscopicity is affected with the type of diluent added, indicating further manipulation needed of the powder composition. Accomplishing this will improve wildlife rehabilitation efforts for the treatment of Aspergillus fumigatus in the mallard duck population.

Charge Carrier Diffusion Properties of Hybrid Perovskites

Juan Lopez Lopez
Sponsor: Dong Yu, Ph.D.
Physics

In recent years, halide perovskites have been gaining intense attention as upcoming materials for photovoltaic applications due to their high carrier mobilities and manipulatable optical bandgaps. However, a substantial amount of research is still needed on the development of perovskite-based field-effect transistors. Major understanding of the charge transport diffusion behavior in hybrid lead halide perovskite crystals is needed for advancing their use in high-performance photovoltaic devices. In this project, we developed a spatially-confined inverse temperature crystallization procedure which synthesizes smooth single crystals of methylammonium lead iodine perovskites ($MAPbI_3$) with dimensions ranging from hundreds of microns up to 1 mm wide, and a constant 2.5 µm thickness. Utilizing scanning photocurrent microscopy (SPCM), the carrier diffusion length was extracted through graphical data analysis. The effects of temperature, bias voltage, and gate voltage on diffusion length were analyzed. From this, extension was seen to occur at low temperatures, where diffusion lengths expand, and charge carriers travel freely. Bias potential did not seem to drastically affect diffusion length, while some gate response was observed. Our work catalyzes the usage of hybrid perovskites in next-generation electronics and benefits the integration of $MAPbI_3$ into ambipolar transistors.

The Association of Pesticide Regulatory Compliance on Pesticide-Related Illnesses

Sabrina Loureiro
Sponsor: Theresa Keegan, Ph.D.
MED: Int Med Hem/Onc

California has one of the most stringent pesticide regulations in the country. However, no prior studies have examined the impact of regulatory procedures on area-level pesticide exposure levels. This study utilized pesticide usage, pesticide regulatory violations, and pesticide-related illnesses at the county-level to assess the association between regulatory compliance and the incidence of pesticide-related illnesses. Illness outcomes, such as the total cases of pesticide related illnesses, total cases with disability, total cases resulting in hospitalization, and the incidence of non-Hodgkin lymphoma were compared across California counties with varying levels of pesticide usage and regulatory compliance rates. A higher level of pesticide usage per square mile was associated with the total cases of pesticide-related illnesses (R^2=0.4335, p=<0.0001). A positive correlation between pesticide usage and total cases with disability was also found (R^2=0.1768, p=0.0062). A modest positive association was observed between pesticide use and the total cases resulting in hospitalization (R^2=0.1034, p=0.0403). However, we did not observe correlations between compliance rate and any illnesses considered. While pesticide compliance rates were not positively correlated with pesticide-related illnesses, we found that pesticide usage was correlated with the total cases of pesticide-related illnesses, total cases with disability, and total cases resulting in hospitalization.

Electrochemical Wave Reflection in Cardiac Tissue

Vincent Lovero
Sponsor: Timothy Lewis, Ph.D.
Mathematics

Each beat of the heart is preceded by an electrochemical wave that spreads through the cardiac tissue. In order for the heart to effectively pump blood, this wave must propagate in a coordinated manner. However, coordination can be disrupted by tissue heterogeneities that arise in diseased states, such as ischemia. In one such disruption, waves are "reflected" of the heterogeneity, are thought to trigger life threatening arrhythmias. Unfortunately, the mechanisms underlying reflections are unclear. To identify the conditions that promote wave reflection, we construct a model of cardiac tissue with an ischemic region, and use numerical experiments to assess how the shape of the ischemic region effects the propensity for reflections. We find that reflections occur in a crescent shaped region of a-b parameter space, where a is the width and b is the length of the ischemic region. In future work, we will identify biophysical parameters of the heart tissue(i.e. ones that can be modulated by anti-arrythmic drugs) that minimize the size of the crescent shaped region, and therefore potentially prevent reflections and the onset of deadly cardiac arrythmias.

Computational Analysis of Synaptic Gene Expression in High-Grade Gliomas

Henry Low
Sponsor: Elva Diaz, Ph.D.
MED: Pharmacology

High-grade glioma is a category of aggressive, uncurable cancers of the central nervous system (CNS) that causes thousands of deaths annually. While its pathophysiology is not yet fully understood, recent research has discovered a major mechanism by which the disease spreads, revealing that glioma cells can electrochemically promote tumor growth by using pseudo-synaptic structures to integrate themselves into neuronal networks. This stipulates that signal transduction pathways involved in the establishment of these artificial synapses are potential therapeutic targets. To investigate a selection of candidate genes possibly engaged in this malignant synaptic-formation process, I performed a series of computational analyses on single-cell transcriptome datasets. Using RStudio, I analyzed RNA-sequence reads in H3K27M+ diffuse midline glioma (DMG) xenograft models to characterize the expression profiles of several genes involved in normal synapse development. Preliminary findings indicate high expression of two members from the brain angiogenesis inhibitor (BAI) subfamily of adhesion G protein-coupled receptors: BAI2 and BAI3, which are believed to function in synaptogenesis and regulation of excitatory synapse connectivity, respectively. I am currently evaluating gene enrichment in multiple glioma types relative to non-malignant levels and plan to conduct cross-sequence comparisons of BAI2/BAI3. This work will hopefully help inform our understanding of glioma progression.

Coordination Chemistry Combining Gold and Tungsten Complexes

Christopher Lowe
Sponsor: Alan Balch, Ph.D.
Chemistry

The novel, bimetallic complex, $(CO)_5WNCSAu(PPh_3)_3$ was first discovered accidentally while trying to isolate a ligand-stabilized form of a $W@Au_{12}$ cluster. Since this discovery, changes have been made to reproduce this complex to learn more about the coordination chemistry between the two metal complexes. The synthesis was optimized in air-free conditions. Initial troubleshooting of the photochemical reaction to form metastable $(CO)_5W(THF)$ complex was performed. This was followed by determining an efficient reaction time to complete the ligand exchange of THF to a more thermally favorable thiocyanate ligand coordinated to the gold complex. The structure was determined through single crystal x-ray diffraction and verified with infrared spectroscopy. Adapting a similar procedure, various bridging ligands are being investigated to synthesize similar binuclear gold(I)/tungsten(0) complexes. These novel bimetallic complexes will be studied to further understand their properties and reactivities.

qPCR Analysis of mRNA Transcript Levels of HuH-7 Cells Using Chemically Modified Anti-miR122

Shannon Lu
Sponsor: Peter Beal, Ph.D.
Chemistry

MicroRNAs (miRNAs) are noncoding RNAs (20-23nt) that mediate the gene silencing pathway RNA interference (RNAi). MiRNAs bind to messenger RNAs bearing sequences that are complementary to their seed region (nucleotides 2-8), preventing target mRNA translation. They are crucial regulators of cell growth and differentiation, however, overexpression has been implicated in cancers and developmental anomalies. Thus, antisense miRNA oligonucleotides (anti-miRs) are under development to inhibit upregulated miRNAs. Anti-miRs contain a myriad of chemical modifications designed to improve their nuclease resistance, potency, and binding affinity to target miRNAs. However, there are few reports of studies towards optimizing anti-miRs to enhance binding affinity towards Argonaute2 (Ago2), the active component of RNAi. We have previously designed modifications on the t1 nucleotide of anti-miRs, which interacts with the t1 adenosine (t1A) binding pocket of Ago2, and identified a few triazole substitutions for adenosine on anti-miR21. These triazole substitutions increase potency as determined by the dual luciferase assay on HeLa cells, which contain upregulated levels of miR21, and demonstrate reproducible activity in anti-miR122, which targets upregulated miR122 in HuH-7 cells. We are thus assessing the downstream effects of anti-miR122 in upregulating endogenous miR122 targets by measuring target mRNA transcript levels with reverse transcriptase quantitative PCR (RT-qPCR).

Deconstruction of Self and Ethical Implications in Humean and Buddhism Philosophy

Siling Lu
Sponsor: Thorian Harris, Ph.D.
Philosophy

Descartes famously claimed that the one thing which he is absolutely certain and cannot be doubted is the existence of himself as a conscious thinking subject. But the existence of the self has been challenged, both in the east and west. David Hume maintained that there is only a bundle of memories, perceptions, and thoughts, but no underlying subject or self which "has" them, or to which they belong and are held together. Buddhists also reject the existence of a self that persists through time. What are the implications behind their theoretical rejection of self? How does this metaphysical thesis influence ethical claims in Humean and Buddhism philosophy? Since both Hume and Buddhism ground our moral principles in our feelings of sympathy with other people, it is reasonable to infer that the deconstruction of self plays an important role in cultivating sympathy for others, which is essential for living an ethical life.

Income Inequality and Household Leverage

Stephanie Lu
Sponsor: Giovanni Peri, Ph.D.
Economics

Research has shown that as household leverage increases, recessions become likelier and more severe. Household debt in the US has risen dramatically in recent times, from 47 percent of nominal GDP in 1980 to a peak of 94 percent in 2009, and down to 74 percent in 2019. Previous literature has shown that an increase in credit supply is the most likely progenitor of household debt, but the causes of credit supply increases are still unclear. One possibility is that as income inequality grows, top income earners funnel their savings into credit for lower income earners. Using the Federal Reserve's Distributional Financial Accounts, I investigate whether income inequality in the US as measured by top earners' share of income is related to increased household leverage at the bottom of the income distribution. I also perform a cross-sectional analysis of income inequality and household debt by using state-level data from the Federal Reserve.

The Effects of Germanium Concentration on the Thermal Conductivity of Amorphous Silicon-Germanium

Nicholas Lundgren
Sponsor: Davide Donadio, Ph.D.
Chemistry

Many amorphous solids are used as component materials in applications where the control of the temperature is important for component lifetimes and efficient use of power. Amorphous silicon-germanium films, specifically, are often used in solar power capture where it is desirable to have constant performance under variable heat flux. Unfortunately, the theoretical understanding of thermal transport in these systems is hazy because of the lack of short-range structure on which most computational models rely. By monitoring the thermal conductivity of a two-species amorphous system change in response to relative concentrations, we provide a description of the role of the system disorder in the thermal conductivity measurement. The thermal conductivities are calculated for amorphous silicon germanium systems with germanium concentration ranging from 0 to 100% using the quasi-harmonic Green Kubo approach to lattice dynamics developed by Ilsaeva et. al. in 2019. This work provides an atomistic understanding of how the disorder affects heat transport properties in semiconductors with important technological applications, and represents a step forward in the path of artificially designed material with selected thermal properties.

DNA Editing in DNA/RNA Hybrids by Fusion Proteins of Adenosine Deaminases that Act on RNA

Michelle Luo
Sponsor: Peter Beal, Ph.D.
Chemistry

Adenosine Deaminases that Act on RNA (ADAR) are RNA-editing enzymes that catalyze the hydrolytic deamination of adenosines to inosines with a known substrate requirement of A-form dsRNA. Since DNA/RNA hybrids are ubiquitous in genetic transfer processes (e.g. transcription of DNA into RNA) and also have A-form helical structure, ADAR proteins have potential as an alternative method of genome editing. Previous in vitro work has shown over 80% editing on the DNA strand of a DNA/RNA hybrid substrate by human ADARs 1 and 2. This study investigated using ADAR fusion proteins containing a hybrid-binding domain (HBD) from human RNase H1 to increase ADAR editing efficiency on DNA in DNA/RNA hybrids. A hybrid substrate of the human glioma-associated oncogene 1 mRNA was used. Thus far, no increase in editing or selectivity was observed between a HBD fusion construct of ADAR 2 catalytic domain (38.68 ± 6.34%) over the ADAR 2 catalytic domain (25.57 ± 7.82%) or the native RNA-binding domain construct (88.42 ± 3.81%). Further experiments with proteins containing multiple HBDs may be necessary to increase substrate binding and efficiency of the fusion protein.

Targeted Meiotic Recombination in *Arabidopsis thaliana*

Van Ly
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Climate change will have major detrimental effects on agriculture. Breeders can introduce traits for climate change resilience into crops by crossing them with wild relatives and selecting progeny with the desired traits. However, this can be difficult if the underlying genes are located on the same chromosome. Reshuffling of these “linked” traits depend on meiotic crossovers to recombine alleles between the parental chromosomes during meiosis, which does not happen uniformly along chromosomes. We are using the model plant Arabidopsis thaliana to test whether we can direct crossovers to a specific location on a chromosome, which is expected to facilitate the generation of desired trait combinations. We are constructing plasmids expressing a guide RNA and a nuclease-dead Cas9 (dCas9) fused to a crossover enhancer protein. We expect that transforming these plasmids into the A. thaliana genome will increase the frequency of meiotic recombination at the guide RNA target location. We will cross the transformed plants to fluorescent reporter lines of A. thaliana which can detect whether a crossover has occurred. Currently, the constructs we have made differ in crossover enhancers and promoters. We are waiting to obtain transformed plants for crosses to the reporter lines while we prepare new constructs.

The Correlation Between Crystal Structure Type and Enthalpies of Formation

David Lyday
Sponsor: Scott Mccormack, Ph.D.
Materials Science&engineering

The complex crystal structures that form the backbone of the material properties we take advantage of every day might have an interesting correlation with the internal energy and work of the system; which in physics is described by the concept of enthalpy. Thermodynamics foundation is based on the idea of entropy increasing disorder due to the probabilistic nature of the chemical world while heat in the form of enthalpy can counteract this disorder allowing the creation of complex structures. The quantities of energy that describes enthalpy and entropy has been compiled by Moscow University in the Chemnet database which allows for a baseline for a relatively small sample of all the possible combinations of the elements on the periodic table. By compiling and comparing enthalpy and entropy of formation with the crystallographic structure machine learning can be used to potentially discover trends in materials. The crystal structure of materials is a predictable repeating pattern of the system in a semi infinite grid which gives the material its properties. By using the machine learning algorithm the pattern and energies can predict materials that can potentially be used in cathodes, anodes, piezoelectric and other structurally complex devices.

The Murder Mystery Paradigm: A New Approach to Studies of Memory for Complex Events

Jessica Macaluso
Sponsor: Charan Ranganath, Ph.D.
Psychology

Real-world memories are built on complex events, and our past experiences, choices, and biases may affect the way we remember details. However, laboratory experiments studying memory have historically been simplistic (i.e. list learning) and may not capture these important aspects of real-world episodic memory. To address this, we created an immersive and realistic murder mystery task. Because a murder mystery is a familiar and existing scenario, participants can easily understand and navigate through the plot. While each participant experiences the same storyline, they may focus on different details within the story; their impressions may dilate the story they witness and ultimately alter their suspicion of different characters. Thus, like real life, information in our task is gained by actively exploring and making predictions about situations. Planned analyses include assessing correlations between variables of interest such as verifiable details and the level of suspicion of each character. We predict that the proportion of details recalled about a particular character will correlate with the suspicion of that given character. Findings from this experiment may offer insight into the role of bias and prediction in real-world recall experiences, such as eyewitness testimony.

Detection Of Cardiac Tissue In Experimental Images

Angyu Lyu
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Detection of objects in experimental images is non-trivial especially when the shape is indefinite. The shape of the heart is changing when it is beating. In addition, each heart has a different shape and size. Usually, signals from outside of the tissue are weak random noise and affect statistical values such as mean and standard deviation of experimental data. Therefore, when we analyze experimental data, it is important to exclude signals from outside of the tissue. In this research, we analyzed rabbit heart images and detected the edges of the heart. We employed various algorithms and compared the results. The edges are the places where the intensity changes significantly. Therefore, first, we used the color difference (gradient) in the images.Second, we used the time series of the data using the fact that signals from outside of the tissue are weak and random. We also used a machine-learning algorithm. A convolutional neural network is often used to detect abnormal electrocardiogram signals recently. We employed a similar algorithm to distinguish signals from cardiac tissue and noise from outside of the tissue. This study is the first step to automate the detection of cardiac tissue in experimental data.

Epigallocatechin-3-gallate (EGCG) Modestly Enhances the Anti-cancer Effect of 5-fluorouracil and doxorubicin by Inducing Apoptosis in Multiple Cancer Cells

Jazmin Machuca
Sponsor: Gerardo Mackenzie, Ph.D.
Nutrition

Previous studies in our laboratory have shown that Epigallocatechin-3-gallate (EGCG), a polyphenol found in green tea, reduces pancreatic cancer cell growth in vitro and in vivo. However, EGCG's effect on other cancer types remains unknown. In this study, we evaluated the anticancer effect of EGCG, both alone and in combination with commonly used chemotherapeutics on colon and lung cancer cells. For this purpose, human HCT-15 colon cancer and human A549 lung cancer cells were treated with EGCG alone or in combination with 5-fluorouracil (5-FU) or doxorubicin for various periods of time (24-72 h). After treatment, cell growth and apoptosis were determined. While EGCG, 5-FU and doxorubicin, alone, reduced HCT-15 and A549 cancer cell growth, they only showed a modest additive effect when given in combination. Comparable results were obtained for apoptosis. For example, in HCT-15 cells, EGCG 0.32 μM and 5-FU 10 μM alone increased apoptotic cell death by 67% and 63%, respectively, and by 79%, in combination. A smaller effect was observed when EGCG was combined with doxorubicin in A549 cells. Our preliminary results suggest that efficacy of EGCG in combination with chemotherapeutic drugs varies depending on the cell type, with some cancer types being more sensitive than others.

Determining the Effects of *Trichoderma asperellum* as Biological Control Agent Against Charcoal Rot in Strawberry

Kaleb Mack
Sponsor: Ana maria Pastrana Leon, Ph.D.
Plant Pathology

Macrophomina phaseolina (Mac), the causal agent of Charcoal rot, is a prevalent fungal plant pathogen of strawberry crops in California. The disease is characterized by the wilting and drying of established plant tissues and the development of charcoal coloured survival structures called microsclerotia. Charcoal rot was controlled for many years by methyl bromide, but have been phased out due to negative environmental implications. In this study, we propose a more environmentally conscious and feasible approach to prevent the disease. Trichoderma spp. based biological control products have been shown to contain multiple effective modes of action such as physical blocking of pathogens from roots, competition for nutrients and space, promotion of plant growth, and a natural alarm system which triggers the plant defense system. Trichoderma asperellum also produces biochemical compounds that limits the growth of and kills pathogens as a form of preemptive exclusion. To determine the effects of the biological control agent, we grew strawberry plants on Mac and Trichoderma asperellum infested soil. Other variables to be compared against were Mac + fungicide, Trichoderma asperellum, and Mac controls. After 10 weeks, disease symptoms will be rated, and plants will be assayed to confirm the relative colonization of the pathogen.

Prevalence of Avian Pox Virus in Anna's Hummingbird (*Calypte anna*) Carcasses

Michelle Mah
Sponsor: Lisa Tell, D.V.M.
VM: Medicine & Epidemiology

Avian pox (genus Avipoxvirus, family Poxviridae) is a virus spread by arthropod vectors or mucosal membrane contact with infectious particles. A hummingbird infected with pox virus can develop wart-like lesions on non-feathered areas of the body, which may negatively impact the birds' biological fitness. Although pox viral infections are widespread and fairly common in many bird species, little is known about the factors that might make hummingbirds susceptible to this virus. This study investigates the prevalence of avian pox viral infections in Anna's Hummingbird (Calypte anna) carcasses from California wildlife rehabilitation centers. Using real time polymerase chain reaction (PCR) testing of tail feather and toenail samples taken from carcasses, the disease prevalence was estimated. A scoring system was established for visual rating of lesion severity and spread for each carcass, and the scores were compared to the PCR viral load results for tail feather samples. Regression analysis was used to compare the positive/negative viral status to covariates such as age, sex, season (time of year at death), and geographic region (Northern or Southern California). This study will help to bridge data gaps in the ecology and epidemiology of avian pox in hummingbirds.

Role of Thermoensitive TRP Channels in Temperature Preference in Mice

Avina Mahroke
Sponsor: Earl Carstens, Ph.D.
Neuro Physio & Behavior

Homeothermic animals avoid hot and cold temperatures and prefer thermoneutral environments. Thermosensitive transient receptor potential (TRP) ion channels play roles in heat and cold sensitivity. TRPV1 is sensitive to noxious heat, TRPV4 to warming, TRPM8 to cold, and TRPA1 to extreme cold. We presently investigated the role of TRP channels in temperature preference using wildtype (WT) mice and knockout (KO) mice lacking TRPV1, V4, A1 or M8. Using a thermal gradient(15-45ºC) assay, female mice of all genotypes (except TRPA1KOs) preferredsignificantly warmer temperatures compared to males. Male TRPM8KO mice preferredcooler temperatures than WTs. Using a thermal preference assay, all genotypes except TRPM8KOs exhibited no preference for slightly warmer or cooler temperatures (25-35°C) compared to thermoneutral (30°C), and avoided colder and hotter plates. Both male and female TRPM8KOs were indifferent to colder temperatures, spendingequivalent time on the colder or neutral plate; they avoided hotter plates. The datasupport a role for TRPM8 in cold detection. That KO mice lacking TRPV4, TRPV1 orTRPA1 did not did not show respective deficits in warmth, heat or cold detection isconsistent with previous reports and suggest the contribution of additionalthermosensing mechanisms.

Environmental and Performance Testing of Hard Disk Drives as Low-Cost CubeSat Reaction Wheels

Eric Mai
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Hard Disk Drive (HDD) tech demonstration of the ADCS for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Commercial CubeSat reaction wheels cost on the order of 10^4 to 10^5 USD. REALOP will repurpose 30 USD hard disk drives, typically found in laptops and iPods, as a low-cost alternative to commercial reaction wheels. Mass-manufacturing of HDDs to high precision standards make them a very reliable and accessible technology. A highly configurable, low cost ESC IC was adapted to control and report the speed of HDD motor for precision attitude control. Appropriate mass and speed properties indicate that HDDs can meet the control requirements of the 2U REALOP CubeSat. Environmental testing is performed on multiple popular and readily-available models of HDDs to verify which can, or cannot, withstand launch and orbit conditions. Performance testing is conducted on an air-bearing testbed to characterize the HDDs and demonstrate that they meet mission pointing and stabilization requirements. Successful integration and on-orbit testing can further prove the utility of HDDs as reaction wheels for low-budget small satellite missions.

Positivity Bias in Verbal Episodic Memory for Native versus Non-Native Speakers

Victoria Maichel
Sponsor: Beth Ober, Ph.D.
Human Ecology

In prior experiments, our lab investigated potential differences in positivity bias for young-adult native English speakers (E1) vs. non-native speakers (E2). Across three verbal learning and memory experiments, we have obtained a significant language-related positivity effect (i.e., language x valence interaction), due to E2 speakers showing greater memory advantage for positive versus negative English words. In prior studies, each subject was given one long, mixed list of positive and negative words, from several semantic categories. The main purpose of the current study was to determine whether our language-related positivity effect would be replicated with a different type of list-learning paradigm, involving the learning of associations between meaningless symbols and five-word lists. Each "mini-list" was either positive, negative, or neutral, and contained either category co-members or unrelated words. Using this paradigm, we specifically aim to assess E1-E2 differences in: (a) positive versus neutral, as well as negative versus neutral, word recall; (b) modulation of valence effects by categorized versus unrelated word lists; and (c) valence versus category clustering for the overall, delayed, free recall trial. Data collection is ongoing; our poster will showcase preliminary findings.

Hyperactive RNA Editing Enzyme Study of Vital Hydrogen Bond Linkage Between Active Site and Inositol Cofactor

Kimberly Maldonado
Sponsor: Andrew Fisher, Ph.D.
Chemistry

Adenosine deaminases acting on RNA (ADARs) are highly conserved enzymes that selectively convert adenosine to inosine in duplex RNA. Inosine is read as guanosine by cellular translational machinery giving rise to a variety of transcripts and susceptibility to mutations. Aberrant editing of ADARs has been linked to disease, prompting us to ask how ADARs are regulated. Structural studies of the catalytic domain of human ADAR2 (hADAR2d) confirm the presence of an unexpected heavily charged inositol hexakisphosphate (IP6) cofactor linked to the active site by a highly conserved hydrogen relay of three residues. This study focused on determining the effect of perturbing this conserved hydrogen-bonding network on the known hyperactive editing mutant, hADAR2d E488Q. Preliminary data found that single mutant's K519M and D392N exhibited no enzymatic activity meanwhile mutant K483M deaminated 35% of the target adenosine. To further examine low editing efficiencies found in this study, we have generated hADAR2d double mutants, E448Q/K483M and E488Q/K519M, with the hyperactive editing phenotype. This may reveal different editing efficiencies compared to the single mutant study, teasing apart the relationship between IP6 and enzymatic activity. Future directions include mass spectrometry to test for the presence of IP6, biochemical and crystallography studies.

"DNA by da Vinci" – A User-Friendly and Efficient Pipeline to Design Whole-Chromosome Paints

Lisa Malins
Sponsor: Luca Comai, Ph.D.
Plant Biology

Whole-chromosome painting is a powerful technique to identify relationships between chromosomes, such as chromosome duplications and translocations, and see these relationships with fluorescent microscopy. Since DNA is double-stranded and follows base-pairing rules, specific sequences on a chromosome can be labeled with probes made from short DNA molecules attached to fluorescent tags. Whole-chromosome paints are collections of many probes designed to fluorescently label entire chromosomes. A sequence library for a whole-chromosome paint can be generated from a genome assembly, but this requires computational tools that are likely unfamiliar to the researchers who could benefit from whole-chromosome paints the most. "DNA by da Vinci" is an efficient, reproducible, and easy-to-use pipeline to generate whole-chromosome paint probe libraries for any organism with a genome assembly. The pipeline is written with Snakemake to facilitate user configuration and transparently show each step, including both custom scripts and popular command-line tools. All software dependencies are installed into a conda virtual environment. DNA by da Vinci works on any organism with an assembled reference genome and requires minimal setup, making chromosome paints accessible to more researchers.

Cardiovascular Risk Factors as an Indicator of Age-Related Cognitive Impairment

Pallavi Malladi
Sponsor: Rachel Whitmer, Ph.D.
MED: Public Health Sciences

Current literature supports that midlife cardiovascular (CVD) risk factors (e.g. obesity, hypertension, high cholesterol, and diabetes) are negatively associated with late-life cognition. Less is known about the relationship between CVD risks developed prior to late-life. Using the Kaiser Healthy Aging and Diverse Life Experiences cohort (KHANDLE; n=1712), we aimed to assess the association between early- and mid-life CVD risks within three age groups (ages 15-28: n= 604; ages 29-34: n=567; ages 35-63: n=541) and cognition assessed in late-life (mean age: 76; range: 65-90). Linear regression analysis showed that individuals with two or more CVD risk factors had lower mean global cognitive test scores (ß=-0.17; 95% CI: -0.28, -0.07) than individuals with no risk factors. Additionally, individuals with high cholesterol (ß=-0.12; 95% CI: -0.23, -0.01) and those who were overweight or obese (ß=-0.11; 95% CI: -0.20, -0.03) had worse global cognitive test scores. Associations were consistent across age groups. These results add to the growing literature highlighting that CVD risk factors in early- and mid-life negatively affect late-life cognition.

Investigating the Relationship Between Accuracy of Nutritional Value Estimates and Diet Choices in Two College Student Populations With Differing Nutrition Knowledge

Camilla Mancuso
Sponsor: Deborah Fetter, Ph.D.
Nutrition

In the United States, some of the most prevalent causes of premature death have been non-communicable chronic diseases such as Cardiovascular Disease, Type II Diabetes, stroke, and certain types of cancers. Research has shown that dietary patterns, physical activity, and weight management are all associated with relative risk of these chronic diseases. The Social Cognitive Theory postulates that in order to change a behavior effectively, one must first obtain behavioral capability. Thus, this theoretical model highlights the importance of dietary knowledge in the control of diet-related conditions. Although various studies have shown that people often underestimate caloric intake, there is a dearth in the literature regarding perception of other nutrients linked to chronic diseases. This study will investigate whether the accuracy of dietary estimates of nutrients, such as fat, sugar, sodium, and fiber, correlate with food decisions between a student group that has taken a college-level nutrition class and a group who has not. The results of the study will highlight potential gaps in nutrition knowledge and thus provide valuable tools for more efficient health-promoting strategies for the prevention and control of some of the diet-related leading causes of premature death in the United States.

Characterization of PKD1 cKO Mice

Avery Mandel
Sponsor: Julie Bossuyt, D.V.M.,Ph.D.
MED: Pharmacology

Protein kinase D (PKD1) is a multifunctional, stress-activated kinase with a critical role in cellular processes including such as actin dynamics, energy substrate utilization, cell growth and survival and gene transcription. In the heart, PKD1 is a key transducer of stress signals and cardiac remodeling, but its role in excitation-contraction coupling is poorly understood. Our aim here is to investigate the role of PKD in excitation-contraction coupling and in mediating Angiotensin II (AngII) effects. Hereto we used cardiac-specific PKD1 knockout mice (cKO) mice and their WT littermates. Fluo-4 loaded, isolated cardiomyocytes were used to visualize cytosol and nucleic calcium handling via confocal imaging. At baseline, we found very little difference between WT and cKO myocytes. Nor did we identify major differences between WT and cKO to acute exposure to AngII (100 nM for 5 minutes). However, following chronic angiotensin exposure (osmotic minipumps 3 mg/kg/day over 2 weeks), cKO mice were resistant to cardiac remodeling as assessed by echocardiogram. Our results clarify the role of PKD in excitation-contraction coupling and demonstrate that PKD plays a key role in mediating chronic angiotensin effects on the heart.

Writing About Enlightenment While Still Trying to Find It

Jeanette Mann
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

Enlightenment takes on many meanings depending on the context. Authors such as Joseph Goldstein, Sharon Salzberg, and Dan Harris have referred to enlightenment as meditation, mindfulness and spirituality. Most people feel they have some wisdom to share when it comes to enlightenment. But when do you have enough to share, to guide, to write a book? There are many books on the shelves boasting they have the answer to help you on your path to enlightenment, but have they themselves walked the path? My study explores this very idea about when you are qualified to write about enlightenment and at what point on the path does the author decide they've gone far enough to write a book. I will be interviewing different enlightenment authors and asking them these very questions. I will also be talking with people who consider themselves on the path of enlightenment and what books they find beneficial and what they look for when choosing enlightenment literature. By speaking with both the authors and the readers I hope to find an answer about when the best time is to put your path down and on paper and when is it most beneficial for others to read it.

The Influence of Reverse Problem Solving on Undergraduates' Success with Stoichiometry Problems

Sukhdev Mann
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry students struggle with interpreting given information in problems and separating relevant information from distractors, causing failures in generating successful solutions. Chemistry educators have implemented different methods such as using solution maps to teach their students how to approach problems and successfully tackle them. However, the effectiveness of problem construction by utilizing given solutions on students' problem-solving achievement has not been studied yet. In this study, a group of chemistry students (N=45) participated in three think-aloud sessions. The group was divided into a control group (N=15) and an experimental group (N=30). During the pre-intervention session, all the students were asked to solve five stoichiometry problems while thinking aloud. After two weeks, the intervention session was conducted in which the experimental group was asked to construct eleven chemistry problems by examining the given detailed solutions. In the post-intervention session, both groups solved slightly modified versions of the pre-intervention questions in order to observe changes in their strategy, knowledge, and accuracy. The goal of this study is to better identify students' struggles with solving chemistry problems, and to examine the effects of problem construction as a potential method to increase students' success with problem solving in chemistry and other subjects.

The Influence of Reverse Problem Solving on Undergraduates' Success with Stoichiometry Problems

Harjeet Mann
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry students struggle with interpreting given information in problems and separating relevant information from distractors, causing failures in generating successful conditions. Chemistry educators have implemented different methods such as using solution maps to teach their students how to approach problems and successfully tackle them. However, the effectiveness of problem construction by utilizing given solutions on students' problem-solving achievement has not been studied yet. In this study, a group of chemistry students (N=45) participated in three think-aloud sessions. The group was divided into a control group (N=15) and an experimental group (N=30). During the pre-intervention session, all the students were asked to solve five stoichiometry problems while thinking aloud. After two weeks, the intervention session was conducted in which the experimental group was asked to construct eleven chemistry problems by examining the given detailed solutions. In the post-intervention session, both groups solved slightly modified versions of the pre-intervention questions in order to observe changes in their strategy, knowledge, and accuracy. The goal of this study is to better identify students' struggles with solving chemistry problems, and to examine the effects of problem construction as a potential method to increase students' success with problem solving in chemistry and other subjects.

Tri-Pack: a multi-functional wearable shelter for homeless individuals

Yuxin Mao
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

According to the United States Interagency Council on Homelessness, California has approximately 150,000 individuals experiencing homelessness. These individuals have multiple overlapping needs: unstable living conditions, protection from the elements, and the ability to change locations often and unpredictably. To address the needs of homeless individuals in a single, affordable, easily-transportable product, we are creating a multi-functional wearable shelter that provides protection while using materials that are upcycled and/or recycled. While products exist to provide mobile shelter in conveniently portable forms, to our knowledge, no product has simultaneously addressed the needs for daytime and nighttime shelter in a single product that also incorporates sustainable materials. Through qualitative interviews, secondary research, and user-testing, we have arrived at a prototype shelter that can also be worn as a garment and transformed into a backpack to hold other items. By combining multiple functions in this prototype, we aim to reduce the number of items an individual would need to carry in order to stay mobile and protected in various urban and rural conditions.

Documenting First Year use of Nest Boxes and Productivity of Secondary Cavity Nesting Birds at Bird Haven Ranch, Glenn County, California

Estefania Maravillas
Sponsor: John Eadie, Ph.D.
Wildlife & Fisheries Biology

In Fall 2018, The UC Davis Museum of Wildlife Fish Biology (MWFB), established a songbird nestbox highway (31 boxes) on Bird Haven Ranch (BHR), Glenn County, California. The objective of this study was to monitor use of boxes on BHR and compare the diversity, productivity and abundance to that of Putah Creek, where MWFB scientists undertake similar surveys. The study involved monitoring bird use of boxes throughout the 2019 breeding season. Weekly visits were conducted from April – June 2019. By monitoring clutches, nestling growth, and banding nestlings, we were able to track box use, nestling growth, and fledgling success. In 2019, 39 clutches were initiated in 30 boxes at BHR. House Wrens accounted for 90% of the broods. On Putah Creek, Tree Swallows were the primary species (57%). Fledgling success at BHR was 88%, greater than that measured on Putah Creek (73%). We will compare results of the 2019 BHR boxes with those of the initiation year on Putah Creek (1999) to determine if species composition is similar in the first year of both projects.

Investigating the Biochemical Diversity of Rubisco, Nature's Most Abundant CO_2-fixing Enzyme

Alyssa Marinas
Sponsor: Patrick Shih, Ph.D.
Plant Biology

Atmospheric CO_2 is "fixed" into life through one enzyme: Rubisco. In plants, Rubisco catalyzes the addition of CO_2 into sugars to sustain photosynthetic organisms, and our entire food supply. Additionally, Rubisco is found across all three domains of life, and is thought to be one of the oldest enzymes on the planet. However, non-plant Rubiscos are infrequently studied, thereby limiting our understanding of one of the earliest hallmarks of terrestrial life. Thus, we aim to purify a diverse set of Rubiscos for kinetic measurements in order to collect data from a broader selection of modern enzymes. To date, we have expressed a variety of Rubiscos, including those from cyanobacteria, proteobacteria, and archaea, in E. coli and are purifying them by affinity chromatography for kinetic assays. We anticipate that the characterization of these Rubiscos that we have expressed and purified will help us better understand the biochemical variability of Rubiscos in nature, as well as re-examine some of the fundamental assumptions about the evolution of life on Earth.

Fracture and Folding at Fault Tips in the Needles Fault District (UT)

Sofia Marino
Sponsor: Michael Oskin, Ph.D.
Earth And Planetary Sciences

Earthquakes are produced by slip across planar surfaces called faults. During an earthquake, energy is partitioned between fracturing and folding at fault tips rather than radiating away as a seismic wave. We measure the fracture density and fold wavelength at fault tips in the Needles Fault District (UT) and investigate the scaling of these parameters with fault length. We measure the fracture density, folding amplitude, and folding wavelength at fault tips through field surveys and high-resolution topographic data. Our preliminary results indicate that strain partitioning is a function of fault length. We propose that slow propagation rates allow for the build-up of elastic strain (deformation) at fault tips, while faster propagation rates result in extensive fracturing. Smaller faults exhibit folding because the propagation rate does not exceed the elastic strain of the surrounding rock. Longer faults have faster propagation rates that exceed the elastic strength of the surrounding rock, producing fractures around the fault tip. This research places quantitative constraints on fracture and fold energy as a strain sink during an earthquake.

The Effect of Dietary Glycerol on Milk Composition and Yield in Lactating Sows

Tanya Marotta
Sponsor: Russell Hovey, Ph.D.
Animal Science

Lactose produced by epithelial cells in the mammary glands acts as an osmotic agent to draw water into milk, thus regulating output volume. While epithelial cells primarily use glucose to synthesize lactose, they can also use glycerol as a precursor to synthesize galactose prior to its incorporation into lactose. Previous studies have shown that supplemental dietary glycerol can alter the metabolism and lactation performance of lactating animals. Given that glycerol fed to sows also increased their milk lactose content, we sought to confirm these findings at different stages of lactation. We hypothesized that supplemental glycerol would increase the lactose content of milk leading to greater milk yield. The study was performed in 4 sows as a crossover design where sows were fed a diet supplemented with either glycerol (GLY; 9%) or cornstarch as a control (CON). Feed intake was measured daily and piglet weight gain monitored over time. Milk composition remains to be analyzed, while milk intake of piglets will be determined from deuterium oxide dilution. A better understanding of the precursors used for milk synthesis can lead to lowered production costs, as well as identifying ways toward modifying the water content of milk for a more sustainable dairy industry.

Biochemical Analysis of ADAR 1 Mutant to Characterize Potential Dimerization Event in ADAR 1 Enzyme

Jonathan Marquez
Sponsor: Peter Beal, Ph.D.
Chemistry

Adenosine Deaminase Acting on RNA (ADAR) is a base-editing enzyme that post-transcriptionally modifies the structure of an adenosine on a double-stranded substrate to an inosine. This structural change in inosine mirrors the structure of guanosine, explaining its affinity to cytosine base pairing. ADAR has recently shown biological implications in regards to immunotherapy, with studies revealing loss of ADAR genes increasing tumor sensitivity to therapeutic agents. We hypothesize that ADAR 1, an Isoform of ADAR, has a dimerization interface that is essential to ADAR's biochemistry-modifying properties. In order to support our hypothesis we introduced a mutation via primer mutagenesis and further expressed our mutated ADAR 1 gene after introducing it into a yeast construct. Once expressed, our ADAR enzyme was analyzed through a size exclusion column and deamination assays to further characterize the success of our hypothesis. If successful, we can further speculate the significance of synthesizing therapeutic agents that target ADAR 1 dimerization interfaces to effectively inactivate the enzyme's function, thus increasing tumor sensitivity to therapeutic agents.

Effects of Stress on Testicular Development

Cynthia Martinez
Sponsor: Trish Berger, Ph.D.
Animal Science

The aim of this study was to look at how stress early in the life of a piglet affected testicular development and ultimately sperm production capacity. The study was conducted on four littermate boars from each of three litters of piglets. Two littermates from each litter were controls and the other two littermates were stressed. Stress occurred between 2 and 5 weeks of age. The stress piglets were placed in a plastic swimming pool by themselves for 5 minutes with no other pigs present. Before the 5 minute mark, a horn was blown to maintain the stressful environment. At 6.5 weeks of age, castration was performed on all boars using local anesthetic. The testicles were then fixed in paraformaldehyde, dehydrated through ethanol dilutions and embedded in paraffin using a Tissue-Tek VIP Processor. Five micron sections were cut from the paraffin blocks and hematoxylin and eosin stained. The tissues were analyzed by measuring the diameter of the largest seminiferous tubule cell and the area of the testicular interstitial space. Tubular diameter and the proportions of the testicular parenchyma occupied by the interstitial space did not differ between treatments suggesting development of the testicles was not affected by this stress.

"From the Portable to the Ivory Tower": Examining the Experiences of U.S.-born Latinx Former English Learners in the UC System

Casandra Martinez
Sponsor: Margarita Jimenez-Silva, Ed.D.
Education

There are 1.3 million English Language Learners (ELL) in California's K-12 public schools. Of those ELL students, 83% speak Spanish. Further, 54% of all public school students are Latinx (all data, California Department of Education, 2018). Little attention has been given to students who were reclassified from ELL status and have now entered higher education institutions. Few statistics are available regarding this population of students. This study interview data to examine the experiences of ten U.S. born Latinx university students who were previously classified as ELLs in their K-12 schooling and currently enrolled at a University of California campus. Qualitative data was analyzed using constant comparison and analytic induction methods to identify and extract common themes across participants (LeCompte & Preissle, 1993). Several techniques were used to support the trustworthiness of the data, including data triangulation, peer review, member checking, and a search for negative cases. Results include lack of confidence in academic reading and writing as well as reluctance to access academic university services. Recommendations include providing targeted assistance for former ELLs that differentiate between their language needs and those of international students and communities for social and academic support for this population of students.

Does Childhood Anxiety Predict Future Phsyiological Regualtion?

Lizeth Martinez Garcia
Sponsor: Paul Hastings, Ph.D.
Psychology

Stressors and adversity are common occurrences in everyone's lives, with some people experiencing them more often than others and to greater degrees. Anxiety is a common stress related response that is experienced by some people with immoderate degrees of worry towards everyday circumstances. Research has identified ways in which automatic physiology predicts current and future anxiety in children. This research study will consider the reverse question and instead examine whether childhood anxiety predicts automatic physiological development from preschool to school age. Based on archival videos, I will examine the behavior of 3.5-year-old children, including facial expression and body language, when they arrive in a novel place (our lab) and meet unfamiliar adults for the first time. Their autonomic physiology was recorded at 3.5, 4 and 6 years. The findings of this research will highlight how physiological development in early childhood may be shaped by children's emotional characteristics like their anxious behaviors.

Examining Changes in Perception of Science Relevancy and Student Career Aspirations Through Integrating Socio-Scientific Issues into General Chemistry Curriculum

Radhika Marwaha
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Students perceive chemistry as a high-level and perplexing subject. Many students fear just hearing the word, "chemistry". Increasing motivation and making chemistry relevant to students' life are important goals in chemistry education and are meant to alleviate this stress. This project's goal is to explore the influence of socio-scientific issues such as Nanotechnology and Alternative Energies on changes in students' career aspirations and attitudes towards the relevancy of science. Two different learning environments on these topics were prepared using Prezi. Relevant sustainability-oriented content was introduced as a part of the information presented with a focus on United Nations' Sustainable Development Goals, along with other global perspectives. The study was completed in three steps. First, students were asked to take pre-intervention surveys and explore the learning environments. Afterwards, during the discussion session, they debated on these topics by assuming real world careers, like economists, scientists and health safety experts. In the last step, they completed post-intervention surveys and highlighted discussion points. Analysis of students' comments and T-tests have been performed to identify statistically significant differences and connect results with demographics, which help conclude whether such interventions are effective in influencing students' attitudes and career aspirations and which groups are benefitted most.

Recovery of ChIP-seq Peaks in Human-specific Segmental Duplications

Mira Mastoras
Sponsor: Megan Dennis, Ph.D.
MED: Biochem & Molecular Med

Human-specific segmental duplications (HSDs) are responsible for the formation of novel genes specific to the human lineage, that may have caused uniquely human traits and diseases to arise. Determining the regulatory landscape of HSDs will be crucial in understanding their putative functions. However, bioinformatic pipelines perform poorly in high identity genomic regions, which makes it a challenge to identify regulatory differences between paralogs. Using a permutation analysis, we confirmed that the ENCODE peak-calling pipeline produces a depletion of regulatory ChIP-seq marks in SDs. In response to this observed depletion, we developed a "multi-mapping" peak-calling pipeline which allows a read to map to multiple highly identical sequences, then uses the program CSEM to determine the most likely allocation of each read. We ran our multi-mapping pipeline on short read ChIP-seq data and demonstrated that it recovers significantly more peaks in HSDs than the ENCODE single-mapping pipeline. We also performed analyses on long-read ChIP-seq data, and showed that longer reads improve confidence in mapping assignment. Going forward, our multi-mapping approach can be used to identify differential expression of HSD paralogs, which will be integral in discovering their functional consequences.

The Effect of Plant Size on the Stomatal Conductance of Four Perennial Grass Species in Northern Arizona

Gautam Mathur
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

Water is a major limiting factor for plant communities in the Southwestern United States and is expected to be further limiting with climate change. As this phenomenon occurs, grasses with different traits will respond differently to water availability. A greater understanding of plant traits can therefore be helpful for predicting the characteristics of communities in the future. The trait this project focuses on is stomatal conductance, which is a measure of the rate of exchange of gasses through pores in leaves, and provides a metric for water use and loss in plants. It is unclear how stomatal conductance varies with plant size, and how that relationship changes with different levels of precipitation. Here we measured stomatal conductance, plant height, canopy length and width, and basal area on four abundant grass species in a mixed conifer meadow on the Colorado Plateau. Data suggests a positive relationship between stomatal conductance and plant size. This suggests that larger individuals would have the ability to exchange gasses at a higher rate, which could indicate a higher access to water or higher photosynthetic activity. As a result, larger plants may be at an advantage to outcompete smaller plants in years to come.

Impaired Spatial Memory in a Rat Model of Alexander Disease

Matthew Matson
Sponsor: Robert Berman, Ph.D.
MED: Neurological Surgery

Alexander Disease is a generally fatal neurodegenerative disorder that results in leukodystrophy and intellectual disability in humans. The disease is caused by mutations in the glial fibrillary acid protein (GFAP) gene in astrocytes, which is thought to prevent the cells from functioning properly. The mutations lead to buildup of protein aggregates called Rosenthal fibers in astrocytes, and degeneration of white matter tracts. A rat model of Alexander Disease, created by producing a point mutation in the Gfap gene, shows several key features of the disease. The objective of the current project was to evaluate spatial learning and memory in this new rat model at two different developmental timepoints. To this end, we used the object location memory assay in which rats must remember the relative location of an object in a test arena. Our findings demonstrate a significant spatial memory impairment in the Gfap mutant rat model of Alexander Disease and will be useful for the future evaluation of potential therapeutics.

Instagram Use

Nicole Matsuda
Sponsor: Nicholas Palomares, Ph.D.
Communication

This study is focused on the effects of Instagram usage on women's body image. Past studies have shown that exposure to messages about body ideals on social media applications, such as Instagram, is correlated with increased levels of body-dissatisfaction and self-objectification among women. We are interested in determining whether perceived similarity and level of endorsement on Instagram mediates the effects of exposure to messages about the body and femininity in a longitudinal quasi-experimental study. We will ask a sample of female undergraduates to follow a set of existing Instagram accounts from one of four conditions: highly-endorsed accounts promoting a body ideal; accounts that are not highly-endorsed that promote a body ideal; highly-endorsed accounts promoting body-acceptance; and accounts that are not highly-endorsed that promote body-acceptance. We will collect data from four points in time across six weeks to determine the effects of exposure to these messages. Findings from this study will potentially help better inform social media users about the effects of exposure to messages about the body.

Dose Response of Basil to Nitrate from an Aquaponics System

Brandon Matsumoto
Sponsor: Jason Gross, Ph.D.
Anr Animal Science

Aquaponics utilizes the biological nutrients from aquaculture in the propagation of agricultural production. This form of propagation is very effective in delivering nutrients to growing plants; but excess nutrients found in the system can have negative downstream effects that can lead to algae blooms, polluted livestock water and effluent pollution. The aim of this project is to determine the relationship between nitrate concentration and plant growth. Effluence from a white sturgeon recirculating system will be used on the commercial production of Genovese Basil. The plants will be propagated using a flood and drain system with a prescribed dilution of effluence (100%, 75%, 50% and 25%) in a series of flats (each containing 200 plants). At the end of the study, plants will be randomly picked and measured for total biomass, leaves, nodes and buds. The resulting data will then be used in future analysis in order to determine the nitrate concentration needed to both optimize plant biomass production while also minimizing effluent waste.

Synthesis and Characterization of Gold Coated Magnetic Nanoparticles

Ornella Mboning
Sponsor: Ting Guo, Ph.D.
Chemistry

Superparamagnetic nanoparticles have attracted a lot of interest recently due totheir ability to be easily manipulated and redispersed in the presence and absence of an applied field. We synthesized 200 nm magnetite (Fe3O4) nanoparticles (NPs) using a solvothermal method and stabilized the NPs with trisodium citrate (Na3Cit) to prevent aggregation. The shape and size of the magnetic nanoparticles were confirmed using transmission electron microscopy. The magnetic saturation (Ms) of the MNPs was measured to be 66.61 emu/g. With a negligible coercivity (Hc) and magnetic remanence (Mr) but a high Ms , the Fe3O4 NPs clearly showed superparamagnetic behavior. Magnetization measurements of the MNPs have been performed by using a superconducting quantum interference device (SQUID.) The optimization of MNPs coated with a gold shell (Au) is an important step to increase their biocompatibility and reduce their cytotoxicity for nanomedical applications. Polyethylenimine (PEI) was assembled on top of the MNPs, 4 nm Au nanoparticle seeds were grown and sonochemically adsorbed on the surfaces of the prepared PEI–modified Fe3O4 NPs. A continuous Au shell grew on the core MNPs by sonochemically-assisted hydroxylamine seeding growth. The characterization of the core-shell Fe3O4@Au were confirmed using TEM, ultraviolet-visible spectrometer and SQUID Magnetometry.

Tactile Air: Exploration in Multi-Sensory Experiences

Rory McCaffrey
Sponsor: Katia Canepa Vega, Ph.D.
Department Of Design

Haptic signaling is important for reinforcing interactions with virtual information; such as vibrotactile notifications commonly integrated with portable electronics. Elastomers have previously been explored with this context for their morphological properties. Soft rubber can be used to mold a cavity which allows air to inflate and deflate, creating surface-level deformations. We propose an alternative method of utilizing soft robotics and pneumatic actuation as a way for creating a single module to produce greater variety and different types of tactile information. The inclusion of a relief puncture releases air in a distinct direction providing mid-air tactile sensation while retaining a high degree of its transformative properties. Additionally, the single perforation alleviates pressure allowing users to subject a greater array of force onto the module without causing it to pop. In this exploration we describe the fabrication process and various trials used to measure the effectiveness in its ability to convey physical patterns.

The Role of Hop2 and its Effect on Fertility

John Mccarthy
Sponsor: Sean Burgess, Ph.D.
Molecular & Cellular Bio

Meiosis is a process that generates unique haploid gametes for sexual reproduction. Homologous recombination (HR) plays a vital role in meiosis by aiding in the proper pairing and synapsis of homologous chromosomes. The process of homologous recombination requires the formation of DNA double-strand breaks (DSB), which allow chiasmata to form between the chromosomes. Hop2 is thought to form a complex with Mnd1 to facilitate the repair of double-strand breaks. To determine how a mutation in Hop2 would affect the production of spermatocytes or oocytes in zebrafish, we analyzed the fertility of hop2 mutants. Our preliminary crosses were used to determine whether hop2 mutants would produce viable offspring. Preliminary data suggests that both male and female mutants are fertile, but further testing is needed to determine if they are sub-fertile or if the gametes are aneuploid. Additionally, mnd1$^{-/-}$ zebrafish are also fertile, and this lack of phenotype in both mutants suggests that Hop2 and Mnd1 may play functionally redundant roles in DSB repair. Our next steps are to establish a hop2, mnd1 double mutant line to discern the role of the Hop2/Mnd1 complex in homologous recombination.

The Role of Septins as a General Cell Stress Sensor in Regulating Cortical Membrane Dynamics

Angelica Mcdaniel
Sponsor: Kenneth Kaplan, Ph.D.
Molecular & Cellular Bio

Under stress conditions, cells initiate pathways that allow for adaptive mechanisms in order to maintain homeostatic balance. In stressed conditions, such as nutrient starvation, autophagic pathways target and lead to degradation of cellular organelles. Cell stress pathways that activate autophagy balance their need for nutrients and the elimination of damaged organelles with continued cell survival and the return to normal cell function, though the mechanisms that orchestrate this balance remain unclear. Our observations that septin filaments relocalize to cortical membrane domains during a variety of cell stresses have led us to hypothesize that septins play a key role in balancing cell viability with the duration of autophagy by controlling autophagic membrane dynamics at ER exit sites. Using the ER exit site marker, Sec16-GFP, we will examine the behavior of ER associated membrane dynamics under various stress conditions such as ethanol, DTT, alpha-synuclein, tunicamycin, and high salt concentration in wild type and septin mutants. We predict that septin filaments at the cortical ER are necessary to constrain the diffusion of exit sites marked by Sec16-GFP.

Production of Novel *Zea mays* diterpenoids Using an Escherichia coli Co-expression System

Liber Mckee
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Plant Biology

Terpenes are a class of biochemically active organic compounds produced in many crop plants. Because the initial terpene precursor molecule undergoes multiple stages of enzymatic modification, there are several different terpene backbone molecular motifs that allow for structural diversity. The resulting repertoire of diverse structures lends themselves to diverse biological functions. Terpenes in Zea mays (maize) are a major component of the plant's response to stress, including drought and fungal disease. Terpenes present potent anti-fungal agents against major maize fungal diseases. Here we use an E. coli co-expression system of maize terpene synthase enzymes to produce the recently-discovered maize diterpenoids termed "dolabralexins" and their derivatives. Dolabrelexins play a role in the drought stress response and may incur specific fungal resistance. With a changing climate and ever more frequent droughts, the exact function and mechanism of dolabrelexins are consequential for continued crop production to feed our growing global population.

The Partition of the Police: How the Police Force in British Mandate Palestine Adminstered the Arab-Zionist Conflict

Maryann Mcnamara
Sponsor: Stacy Fahrenthold, Ph.D.
History

Palestine came under British control in 1917, with the capture of Jerusalem from Ottoman forces during World War I. With the advent of the League of Nations, the Middle East, including Palestine, was divided up along imperial lines to create the Mandate system. The League of Nations, along with the superpowers of Europe, used the mandate system under the guise of a civilizing mission, with Britain promising the creation of a Jewish National Home in Palestine. In this, the Palestine Police used racial categorization to organize the Force and control Palestine. The divisions in the Police set forth British policy in Palestine: one of manufacturing ethno-religious divides between Arabs and Zionists. The pervasive technique of categorizing members of the British administration (the police) and the citizens (both Arab and Zionist alike) exacerbated the conflict and national divide. The Palestine Police Force implemented British policy, but, they were subject to colonial manipulation by the same racialized policies they were charged to implement. This is not to say that the sectarian conflict was not already present in the different ethno-religious communities, but, the British, through the administrative mandates enforced by the police, heightened the tensions.

Synthesis of Binuclear Gold (i) Diphosphine Macrocycles Using Various Non-Coordinating Polyatomic Anions

Lauren McNamara
Sponsor: Alan Balch, Ph.D.
Chemistry

I have synthesized a series of Au_2[μ-bis-(diphenylphosphino)ethane]X_2 macrocycles (where X= $F_3CSO_3^-$, PF_6^-, BF_4^-) that exhibit unique luminescent properties. The macrocycles were formed using a 1:1:1 ratio of Au^+, dppe (where dppe = bis-(diphenylphosphino)ethane), and X^-. The solvoluminescent $F_3CSO_3^-$ analog was crystallized using chloroform and both diethyl ether and toluene as counter solvents. The crystals formed in the chloroform/diethyl ether gradient were initially non-luminescent but displayed teal luminescence upon exposure to air. The crystals produced from the toluene-rich section of the chloroform/toluene gradient were orange-luminescent, and the resultant crystal structure revealed that toluene does not promote the formation of the macrocycle. Instead, toluene promotes the formation of a four-coordinate tetrahedral complex with the formula $[Au(dppe)_2](F_3CSO_3)$. The PF_6^- analog resulted in non-luminescent crystals forming out of a chloroform/diethyl ether slow-diffusion gradient. Single-crystal X-ray diffraction determined these crystals to be a macrocycle analog. Furthermore, teal-luminescent BF_4^- macrocycle crystals were formed out of a chloroform/diethyl ether gradient. The alterations and quenching of emission peaks for each macrocycle are believed to be attributed to solvent interactions and perturbations in aurophilic distances.

Comparative Analysis of Retinal Visualization Methods of a Mouse Model of Diabetic Retinopathy

Sonia Mehmi
Sponsor: Zeljka Mcbride, Ph.D.
MED: Eye Center

Diabetic retinopathy(DR) is an ocular complication that occurs due to diabetes. In diabetes, an increased blood sugar level causes damage to blood vessels in the back of the eye(retina). Small nucleic acids, microRNAs have recently been identified as promising therapeutic agents. The DR mouse model was used in our lab to determine whether our candidate microRNAs can be used as potential inhibitors of DR. The object of this pilot project was to identify which imaging technology would be the most useful to gather the data over a period of time. There were two groups, Group1: control group (PBS injections) and Group2: therapeutic injections. Animals were imaged at the following time points: 0, 7 and 30-days, using in vivo imaging with Micron IV and in vitro imaging of retinal flatmounts followed by confocal imaging. The images were compared between these two techniques at 30-days time point. Our results suggest that in vivo imaging has the advantage of multiple time points with the same animal, while in vitro imaging gave more details, but the animal can be analyzed at just one time point. In conclusion, a combination of the two imaging techniques will be applied to achieve the best results.

Role of WRINKLED1 in Soybean Seed Lipid Biosynthesis

Makenzie Melby
Sponsor: John Harada, Ph.D.
Plant Biology

Soybean is the most produced and consumed oilseed in the world. During the development of the soybean seed, lipids accumulate in large amounts in embryo cotyledons, making the soybean seed one of the most important sources of lipids for both food and biofuel production. The transcription factor WRINKLED1 (WRI1) is characterized as a central regulator of seed lipid biosynthesis in many plant species. However, the contribution of soybean WRI1 homologues for seed oil accumulation is still unknown. In order to identify genes that are transcriptionally activated by WRI1, chromatin immunoprecipitation – DNA sequence analyses and differential gene expression analyses were conducted with developing soybean seeds. Most genes regulated by WRI1 encoded for enzymes involved in lipid biosynthesis in soybean seeds, such as BIOTIN CARBOXYL CARRIER PROTEIN OF ACETYL-COA CARBOXYLASE 2 (BCCP2) and ACYL CARRIER PROTEIN 4 (ACP4). We performed transient assays in protoplasts isolated from soybean embryos to validate the relationship between WRI1 and the promoter of genes involved with lipid biosynthesis. Our results provide a framework to understand the transcriptional regulation of oil accumulation during soybean seed development and will allow for the development of techniques to improve soybean oil production.

Air Force Reserve Officer Training Corps Cadet Guide

Joshua Melton
Sponsor: Carolyn Thomas, Ph.D.
Undergraduate Education

The Reserve Officer Training Corps is a program through which college students can earn a commission into the United States military. Detachment 088 at California State University Sacramento is the host for University of California Davis students in the Air Force ROTC program. The military as an organization has a formal and standardized system for relaying information, however many of these publications are irrelevant or otherwise presented in a fashion that lacks a logical presentation of order and organization for ROTC. The purpose of this project was to create a comprehensive guide for Detachment 088 cadets that is useful throughout the four-year course of the program. Published career guidance is primarily intended for recruiting and information on quotas, and lacks a valuable personal perspective for commissioning cadets. In addition to the agglomeration of relevant literature, the guide includes testimonials from active duty Airmen to shed a real-world light on cadets' potential career fields. The final product was assessed on utility among its intended audience, officer candidates from Detachment 088.

White Identity and Immigration Politics

Esmeralda Mendoza
Sponsor: Bradford Jones, Ph.D.
Political Science

White identity plays a crucial role in understanding how white identifiers form support and opposition towards policies. Whites with strong racial solidarity support legislation that will protect their group's interest, and are a central factor in elections. When proposed legislation aims to reduce racial inequality, White Americans view it as a direct threat to their superior position in the United States. Similar to a zero-sum game, Americans believe that when another community receives more, White Americans will inherently receive less. Thus, strong levels of ethnocentrism are positively correlated to support restrictive immigration policies. Immigration is perhaps one of the single most important issues that can change how a political party is perceived. The increasing Latino support for the Democratic Party has led the majority of Latinos elected officials to become Democrats and support immigration. Therefore, when Whites believe that increasing immigration is causing negative effects in American society, they have a higher motivation to support the Republican Party because the party opposes immigration.

Gender Differences in Behavioral Strategies for Delay of Gratification

Lorena Mendoza
Sponsor: Daniel Choe, Ph.D.
Human Ecology

Early success in delaying gratification has been associated with positive developmental outcomes such as socioemotional competence, better mental health, future career success, and greater relationship quality. Studies of children's self-regulation have found that girls typically perform better than boys on delay of gratification tasks, which measure impulse control; however, it remains unclear which behaviors contribute to girls' better task success. A sample of 70 preschool-aged children (M = 50.8 months, SD = 4.77, 48.6% girls) performed a gift delay task in which children were left alone for three minutes and told not to touch a gift placed in front of them. Task success was defined by whether or not they touched the gift. The following behaviors were behaviorally-coded during the task in ten-second increments: focusing on object, behavior distraction, attention distraction, and passively waiting. With preliminary data (n = 28), there is a marginally significant gender difference in task success in the expected direction, but with a larger sample we expect to find a significantly higher success rate in girls, attributing their success to behaviors in which attention is averted from the gift. Children's ability to self-regulate in early childhood provides a basis for greater academic development and social relationships.

Chiral Organosilicon Compounds as Novel Catalysts and Ligands

Mira Milic
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Organosilicon compounds are ubiquitous in many products that enable our modern lifestyles ranging from polymer materials to agrochemicals to personal care products. Previous work in the Franz group has demonstrated that novel silanediol and disiloxanediol organocatalysts possess hydrogen-bonding and anion-recognition properties; however, enantioselective, chiral-at-silicon variants remain elusive. This work describes a new approach for the synthesis of chiral-at-silicon variants from a prochiral silanediol by employing a chiral amino-acid based catalyst, previously reported by Hoveyda and Snapper to selectively react one alcohol group of a meso 1,2-diol. The goal of this project is to synthesize and evaluate analogs of the chiral amide catalyst containing different Lewis basic heterocycles to promote the selective reaction of one OH group of a prochiral silanediol. The reactions of silanediols will be monitored using in-situ IR spectroscopy methods to compare kinetics and chiral HPLC to determine the enantioselectivity of the process. The results of these methods and kinetic studies will provide insight into rarely studied silanediol desymmetrization reactions and guide incorporation of chiral silanols into ligands and organocatalysts.

Coral Feeding Shapes Foraging Behavior in Butterflyfishes (Chaetodontidae)

Analisa Milkey
Sponsor: Peter Wainwright, Ph.D.
Evolution & Ecology

Butterflyfishes (family Chaetodontidae) are a species-rich group of fishes intimately associated with coral reefs. Butterflyfishes have been grouped into several trophic guilds, including obligate corallivores, which obtain >80% of their diet from hard corals, and benthic invertivores, which feed on attached and free-moving benthic prey. Corallivory has been extensively studied across reef fishes, but there is a lack of research on how corallivory affects foraging behavior. This study explored the relationship between feeding rate and swimming behavior across obligate corallivores and benthic invertivores using video data obtained from 14 species of butterflyfishes. Feeding rate and swimming behavior varied significantly between trophic guilds ($F=152.04$, $p=0.006$). Obligate corallivores had on average higher biting and turning rates than benthic invertivores. There was a significant positive relationship between feeding rate and turning rate across all species after phylogenetic correction ($F=7.681$, $p=0.017$). This study's novel approach to recording fish behavior elucidates how coral feeding has shaped foraging behavior in butterflyfishes.

Parental Care and the Risk of Maternally-Vectored Pathogens: *Ammophila* Transmit Strepsipteran Parasites to Their Young

Rebecca Jean Millena
Sponsor: Jay Rosenheim, Ph.D.
Entomology/Nematology

Extended parental care is important for protection against natural enemies but can also create opportunities for parents to vector parasites to their offspring (vertical transmission). Such opportunities may be occurring in the case of Ammophila wasps. These wasps have varied offspring provisioning behaviors—some species provide a single prey item, but others bring many prey items during successive trips to the nest, creating much more extensive contact between the mother and developing offspring. We hypothesized that each visit by a female to the nest to add another prey item increases risk of offspring parasitism by Strepsiptera, which are tiny parasitic insects transmitted through offspring-mother contact. To test this hypothesis, information on each species' provisioning behavior (mean number of prey items provisioned per offspring) was taken from published literature or field notes. Specimens of various Ammophila species preserved in the Bohart Museum of Entomology were then examined for parasitism by Strepsiptera. As predicted, Ammophila species that receive more prey items have a greater percentage of parasitized individuals. Species that receive a single prey item showed no evidence of parasitism by Strepsiptera. These findings provide more insight on how extended parental care can augment, rather than reduce, risk to offspring in certain cases.

Characterizing Structure-Function of Plant Organ Growth Regulating Complex

Avalon Miller
Sponsor: Nitzan Shabek, Ph.D.
Plant Biology

Final organ and seed size have a high correlation to overall performance of crops and their yields. A major pathway shown to be involved in this process is the ubiquitin-mediated control of a peptidase, DA1, by its E3 ligases—DA2 and BB. This complex, DA1-DA2-BB, has been shown to alter the cell cycle transition between periods of cell proliferation and cell expansion in the plant through ubiquitination. This regulatory relationship has been demonstrated through mutagenesis studies, but the molecular mechanisms behind this ubiquitin-mediated pathway have yet to be determined using a structure-function analysis. Using molecular and biochemical tools, we have cloned each gene into specific E. coli expression vectors through ligation-independent cloning, transformed and expressed the proteins in E. coli, and purified the proteins through chromatographical methods. Our future goals include testing for complex formation with chromatography, crystallizing the complex and each protein involved, and finally, determining the atomic structure by x-ray crystallography. Further structure-function characterization of this complex will contribute novel insight into understanding the molecular mechanisms behind final plant organ size determination.

Modelling Gene-Tree-Species-Tree Conflict in Phylogenetic Trees with Migration

Haleigh Miller
Sponsor: Bruce Rannala, Ph.D.
Evolution & Ecology

From virology to conservation biology, phylogenetic trees are ubiquitous across scientific disciplines. To infer a phylogenetic species tree from genetic data, a researcher encounters a common question: which software program should they use? The choice is often between a Bayesian inference tool, which is statistically rigorous but computationally intensive, versus a summary-statistic tool, which is a heuristic but computationally efficient. Does the increased performance of the rigorous method justify the increased computational cost? Both methods derive from the Multispecies Coalescent Model, which assumes there is no selection on the genes, no migration between populations and no recombination within loci. This raises another question: is one class of methods more resilient to violations of model assumptions, such as migration, than the other? To address these questions we developed a statistical model that predicts the probabilities of particular genealogical relationships among DNA sequences (gene trees) when migration occurs between species. Using this model, we will investigate how the probability that the gene tree mismatches the species tree changes with different patterns of migration (regions of parameter space). These regions of parameter space are significant because gene-tree-species-tree discordance can cause erroneous estimates of species phylogeny.

Determining the Structure-Function Relationship of Maize Diterpenoid Anti-Fungal Activity

Hana Minsky
Sponsor: Philipp Zerbe, Ph.D.
Plant Biology

Maize (Zea mays) is a major staple crop essential to global food security and renewable biofuel production. Rapid climate change, along with pests and pathogens, can cause severe harvest losses. It is therefore crucial to understand plants' natural responses to environmental stressors. Plants produce a range of small molecule metabolites in response to stress. For example, many major crops such as maize and rice (Oryza sativa) produce diterpenoid metabolites to combat fungal pathogens. The newly characterized group of maize diterpenoids, termed ‘dolabralexins,’ show significant antifungal activity against multiple species of the devastating crop pathogen Fusarium. Despite the importance of dolabralexins, the mechanism underlying their bioactivity is still unresolved. We analyzed the inhibitory effects of dolabralexins on fungal growth using in vitro fungal bioassays. We demonstrated that biologically relevant concentrations of dolabralexins inhibit the growth of various Fusarium species. Furthermore, we elucidated the structure-function activity of dolabralexins, demonstrating that an epoxide functional group is necessary to inhibit fungal growth. Understanding the mode-of-action underlying dolabralexin antifungal activity will allow us to use these natural crop defenses to develop novel diterpenoid fungicides and to breed or engineer plants that can better withstand fungal diseases.

A New Radial Basis Function-Finite Difference Approach for Modeling Mantle Convection

Christianson Mills
Sponsor: Maxwell Rudolph, Ph.D.
Earth And Planetary Sciences

Understanding the evolution of Earth’s interior requires a quantitative model of heat and mass transport by convection in the mantle. Although simplified analytic and semi-analytic solutions exist for many idealized problems related to mantle convection, simulations which account for heterogeneity in parameters like density, viscosity, and composition are only possible through numerical methods. Here, we study the properties of a radial basis function-finite difference (RBF-FD) method and its relevance to this application, using moving nodes to numerically solve the advection-diffusion equation and drive a two-dimensional simulation based on the principle of conservation of energy. We also apply conservation of momentum to the model via numerical solution of the Stokes equations. RBF-FD methods are promising for this purpose because they can be applied to large scale problems, and can be easily modified to obtain higher order accuracy. We will compare numerical results of our RBF-FD implementation with results obtained using more traditional finite-difference and finite-volume techniques and discuss the potential of scaling this technique to larger problem sizes.

Impact of Decreased Visibility on Courtship Behavior of the Greater Sage-grouse (*Centrocercus urophasianus*)

Kimberly Mitchell
Sponsor: Gail Patricelli, Ph.D.
Evolution & Ecology

Habitat structure can have a major effect on a species’ social behavior and interactions. Greater sage-grouse (Centrocercus urophasianus) are birds that mate on breeding grounds called leks, areas where males congregate to engage in courtship displays. Most research has been done on open leks with few shrubs and high visibility. However, sage-grouse also lek in areas with heavy sagebrush cover. This project analyzes the effects of limited visibility on sage-grouse by setting up a barrier on a flat, open lek among the displaying males. This barrier was composed of a series of burlap walls designed to limit visibility, but not noise or movement. Previously, I analyzed mating success data and found that visual barriers have no significant effect on mating success. This current project examines the effects of decreased visibility on courtship behavior itself (struts). Strut data was then collected from males within 5 meters of this barrier and compared to data collected when the barrier was not present. Preliminary results show that decreased visibility has little effect on courtship behavior. As sage-grouse are a species of significant conservation concern, understanding their responses to environmental manipulation may help inform more effective decisions regarding habitat preservation and mitigation.

Single Axis Rotation Testing to Determine Camera Performance Thresholds for UC Davis' CubeSat Mission

Christine Mitroff
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

A critical component to the success of UC Davis' REALOP CubeSat mission is the ability to remotely take clear images of the Earth while in orbit. The goal of this study is to design a controlled testing setup which emulates an orbiting CubeSat to help establish a rotational threshold for which pictures taken by the CubeSat's onboard camera are of acceptable quality for the mission's requirements. An air bearing table is used to produce a low friction, freely rotating surface for testing the Raspberry Pi V2 Camera Module. Experimental parameters for the camera include the picture resolution and the lighting environment. Successful demonstration of the air bearing table for free rotation testing not only determines the requirements for the CubeSat's ADCS (Attitude Determination and Control System), but also serves as a basis to quantify the performance of other components such as reaction wheels and sun sensors to satisfy the mission's requirements. Characterization of the camera will also support its use in missions outside REALOP and in other low budget university satellite missions.

Cytotoxic Effects of Engineered Nanomaterials on Primary Mouse Tracheal Epithelial Cells

Kevin Mo
Sponsor: Laura Van Winkle, Ph.D.
Cntr For Health & Environment

Engineered nanomaterials (ENM) increasingly are incorporated into consumer products because of their functional advantages such as reactivity, conductivity, and surface area. These same attributes of ENMs (1-100nm) allow them to be suspended in aerosols to which humans can be exposed by inhalation. To investigate the extent of cytotoxicity in the respiratory system, primary mouse tracheal epithelial cells were grown to confluence onto an air-liquid interface (ALI) culture medium and exposed to ENMs including: copper oxide (CuO), cadmium sulfide (CdS), graphene oxide in water (GO H_2O), molybdenum disulfide (MdS), hexagonal boron nitride (HBN), graphene oxide 250nm x 250nm (GO 250), graphene (110nm x 110nm), and reduced graphene oxide (RGO). The confluent cell cultures were exposed apically to ENMs resuspended in solutions of 125 or 250 ug/ml. Cytotoxicity was quantified using fluorescent microscopy to directly measure live cell density. We found that HBN, graphene, and RGO at 250 ug/ml as well as GO H_2O at 125 ug/ml resulted in reduced cell viability. The remaining ENMs did not demonstrate significant cytotoxicity. This study reveals that the aforementioned ENMs cause cytotoxicity in lung cells.

Msh4 SUMOylation Regulates Meiotic Crossing Over

Michael Moezpoor
Sponsor: Neil Hunter, Ph.D.
Microbiology & Molec Genetics

Meiosis is the cell division process that produces haploid gametes via two successive rounds of chromosome segregation. Accurate segregation of homologous chromosomes at the first meiotic division relies on chromosome pairing, synapsis and crossing over. Defects in these processes are a leading cause of infertility, miscarriage and congenital disease in humans. SUMOylation is a post-translational modification involved in the regulation of many aspects of nuclear dynamics and chromosome metabolism. Recent studies have demonstrated that SUMOylation has a critical role in the regulation of meiosis. Our long-term goals are to discover specific targets of SUMOylation during meiosis and understand how SUMO regulates their function. The Msh4 and Msh5 proteins form a heterodimer that facilitates meiotic crossing over by stabilizing the DNA joint-molecule intermediates of homologous recombination. In this study, we identify budding yeast Msh4 as a SUMO target, show that SUMOylation is important for the crossover function of the Msh4-Msh5 complex, and reveal
how SUMOylation modulates the function of Msh4.

Protein modification by the small ubiquitin-like modifier, SUMO, promotes chromosome crossing over by targeting the Msh4 protein.

Marjan Moghaddam
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Microbiology & Molec Genetics

Defects in meiosis are the leading cause of infertility, pregnancy loss, and congenital diseases such as Down syndrome. Initially, the DNA is duplicated, creating four full sets of chromosomes, and then one of each chromosome is distributed to each gamete cell (sperm or egg). Precise segregation requires chromosome pairing, synapsis, and crossing over. Chromosome crossing over a complex called MutSγ, composed of Msh4 and Msh5 proteins. Here we show that a specific post-translational modification on the Msh4 protein, called SUMOylation, helps activate the crossover function of MutSγ. Mutations that prevent SUMOylation of Msh4 results in reduced crossing over, chromosome missegregation and inviable gametes. To confirm that failure to SUMOylate Msh4 is responsible for these defects, we attempted to rescue cells by fusing SUMO directly to Msh4. We found that fusion of SUMO to the C-terminus of Msh4 significantly rescued the crossover and gamete death defects of the SUMOylation defective Msh4 mutant. By contrast, the fusion of SUMO to the N-terminus of Msh4 was unable to rescue. Our studies provide molecular insights into the role of SUMO modification in meiotic crossing over.

Prior Category Knowledge Aids New Learning

Marjan Moghaddam
Sponsor: Charan Ranganath, Ph.D.
Center for Neuroscience

To make decisions in the real world, humans must be able to update their behavior based on new information. Prior work suggests that using inferred category knowledge can help update previously learned information based on a single observation. In addition, evidence suggests that delay-dependent processes may help with the formation of category knowledge. However, it is still unclear how inferred category knowledge influences new learning and what role delay-dependent processes serve in solidifying category knowledge. We developed a novel paradigm to test the influence of previously learned reward and category knowledge on new learning after a 24-hour delay. On Day 1 subjects viewed a sequence of three items and were asked to predict whether a sequence would produce a reward. Embedded in the sequences were items that changed the probability of reward and through trial and error subjects learned which sequences led to reward. Subjects returned on Day 2 to perform the same task, but the reward probabilities were altered. Category-learning performance was assessed after learning on both days. We predicted that participants' category learning performance on Day 1 would be related to their re-learning on Day 2. Preliminary analyses support our prediction.

The Role of Abscisic Acid in Suberin Deposition of Tomato Roots

Sana Mohammad
Sponsor: Siobhan Brady, Ph.D.
Plant Biology

A plant's ability to react to a changing environment is essential for its survival. To facilitate this, plants have hormones that act as signaling molecules for intercellular communication. One such hormone is abscisic acid (ABA). ABA coordinates responses in the plant, such as increased suberin deposition during osmotic stress. Suberin is a polymer found in many tissue types, including the outer layer of some plant roots, creating a barrier which aids in drought tolerance. Suberin deposition still occurs at a basal level during normal development, but it is unclear whether or not ABA is also involved at this stage. To investigate this, we focused on three mutant tomato lines unable to synthesize ABA. We grew these mutants along with wild type plants, and collected fractions of roots at different lengths. Roots sections were then stained with fluorol yellow and suberin levels were quantified. Comparing suberin content between these mutants and wild type plants allows us to elucidate whether ABA is involved with developmental suberin deposition or not. Understanding how ABA regulates suberin deposition can help us better perceive how plants respond to changes in their environment. Ultimately, this information can help us breed stress-resistant cultivars.

Structural Determination of a Bacterial Cell-Division Protein using X-Ray Crystallography

Abdulsamad Mohammed
Sponsor: Andrew Fisher, Ph.D.
Chemistry

One method to identify potential ligands for drug discovery and design is cysteine tethering. In this process, a cysteine residue is added to a protein near its active site. This allows small molecules that contain a sulfhydryl group to covalently bind to the mutant protein via a disulfide bond, thereby forming a "tether". Capturing the ligand-protein complex in this manner and examining the binding interactions allows for the optimization of potential drug leads. Tethering relies on X-ray crystallography for atomic-resolution information about the protein-ligand binding. The goal of this research was to identify the crystal structure of a key cell-division protein from Bacillus subtilis, FtsZ, containing a cysteine mutation in order to gain a better understanding of the structure of ligands that tether to it. In order to do this, we conducted crystallization screens to identify initial crystallization conditions, which were then optimized to obtain higher-quality crystals. Crystals were shot with synchrotron X-ray radiation and diffracted to 4 Å. Weare currently processing this data to obtain the structure.

Is Defensive Aggression of Nests Heritable?

Ana-Begona Molina Gil
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Neuro Physio & Behavior

Defending a nest often requires the use of aggression to fend off invaders. Most studies on aggression have focused on courtship and territorial behaviors driven by testosterone, which is largely produced in sexually mature testes. However, we have observed aggression in the context of nest defense in both male and female parents, as well as offspring, suggesting control of this behavior may stem from different biological pathways. Little is known about how physiological mechanisms mediating defensive aggression vary in individuals, and if this is heritable. To investigate, we have been quantifying aggression observed in a rock pigeon (Columba livia) colony and assessing the repeatability of defensive behaviors within individuals over the breeding period. Our intention is to use these data to evaluate whether there is a relationship between the aggression exhibited by an individual and that exhibited by other individuals in its lineage. As studies have found a genetic basis for aggression in chickens, we predict we will discover a heritable component to defensive aggression in pigeons. Overall, understanding the genetic basis of defensive aggression may increase our understanding of the heritability of behaviors.

Investigating the Pulmonary Macrophage Response to LPS Under Hyperglycemic Conditions

Kaitlin Molony
Sponsor: Angela Linderholm, Ph.D.
MED: Int Med Pulmonary (sac)

The manifestation and aggravation of inflammatory lung diseases have been experimentally associated with high sugar diets in obese patients. An explanation for the observed inflammation involves the innate immune response to blood glucose levels. Initial studies in mice provided with high sugar, high fat diets revealed a correlation between high levels of glycolytic metabolites and activation of inflammatory cascade related cells. This study seeks to quantify and delineate a correlation between cytokine expression in inflammatory markers TNF? and IL-6 in response to an assortment of LPS and glucose treatments. By measuring macrophage response to each condition, we may establish preliminary data regarding effects of glucose and LPS, respectively, on immune cell mediated inflammation. Primary bronchoalveolar lavage collected from primates were processed to isolate viable macrophage cells, and subsequently cultured in RPMI growth media containing various levels of glucose and mannitol, and challenged with LPS. ELISA detection assays against TNF? and IL-6 were subsequently performed to measure cytokine levels produced in each condition. According to the ELISA results, primate macrophages responded notably and consistently to LPS treatment conditions. Glucose levels did not appear to have had an effect on cytokine production; future studies involving lung-specific glycolytic metabolite derivatives may be performed.

Understanding the Effects of Iron and Chromium Dopants on Grain Growth and Densification in Fast-Fired Magnesium Aluminate Spinel Nanoparticles

Sevag Momjian
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Engineering Deans Office

Ultradense and transparent Magnesium Aluminate Spinel ($MgAl_2O_4$) is generally achieved at high pressure and temperature sintering conditions. In this study ultradense MgAl2O4 was sought in pressureless conditions by the addition of Chromium and Iron dopants. Respective stoichiometric powders of $MgAl_2O_4$, doped with 2% wt Iron and Chromium were synthesized by method of reverse strike coprecipitation. The resulting powders were then calcinated at 750°C for 6 hours, and ground into fine nano-sized particles. Upon analysis by XRD, the $MgAl_2O_4$ 2% wt Fe had grain sizes of 6.7 nm, $MgAl_2O_4$ 2% wt Cr had grain sizes of 8.6 nm, and undoped MgAl2O4 had grain sized of 5.4 nm. XRD analysis also confirmed that no second phase had formed within the $MgAl_2O_4$. The calcinated powders were then pressed into green pellets and fast-fired at temperatures of 1200°C-1400°C for 1-10 minutes. The undoped $MgAl_2O_4$ reached 95.3% of its maximum theoretical density. The $MgAl_2O_4$ 2% wt Fe reached 97.8% of its theoretical density and the $MgAl_2O_4$ 2% wt Cr reached 98.1% of its theoretical density. Various samples were then imaged using a Scanning Electron Microscope (SEM) to measure grain sizes. Even though ultradense $MgAl_2O_4$ wasn't achieved dopant addition did yield a higher theoretical density.

Can Persuasive Memes Get People to Exercise? Stereotype Threat and Lift Effects on Physical Activity

Enoch Montes
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Communication

This study tested how raising the salience of stereotypes about men and women's physical prowess through memes can influence physical activity. Participants were randomly assigned to one of three meme exposure conditions (stereotype threat, stereotype lift, control) and then asked to perform a running task for ten minutes while onscreen motion-capturing avatars displayed the participant's face. Physical activity was measured with accelerometers and a heart rate monitor. Based on stereotype threat effects, we expect that exposing participants to a meme that threatens confidence in their physical abilities may decrease their cardiac frequency and step count relative to the remaining conditions. These effects may be linked to the concept of "stereotype lift" and "stereotype threat" within the context of exercise-related video games (Li & Lwin, 2015). The data was collected in fall 2019 and preliminary results will be discussed. The findings may illuminate how new technologies may be harnessed to incentivize health-related outcomes.

Living in the Glacial Landscape

Michael Montgomery
Sponsor: Scott Herring, Ph.D.
University Writing Program

During the Pleistocene geologic epoch, Earth oscillated between glacial and interglacial climates in a cyclic process that did much to determine the present configuration of landforms and the trajectory of human evolution. Some recent observers, beyond attempting to understand how or why climate changed in this manner, have made a conscious effort to incorporate lessons from those changes in their everyday lives. Gary Snyder is a prime example. A Pulitzer Prize-winning poet and UC Davis professor emeritus, Snyder has long championed the view that humanity's brief historical moment occurs exclusively and unavoidably "at the tail end of the last ice age," as he once put it. In poetry and prose spanning more than sixty years, Snyder has repeatedly referred to ice ages and glaciers as forces of creative destruction that remind us of the vastness of time and the inevitable, regenerative nature of change. By synthesizing these references and placing them in the proper scientific context, which includes literature in geology, climatology, archaeology, and paleoecology, I hope to demonstrate why, with anthropogenic global warming an ever greater cause for concern, an interdisciplinary, long-term perspective on climate history is now more important than ever.

Optimization of *Agrobacterium*-Mediated Strawberry Transformation Method

Lucero Morales
Sponsor: John Yoder, Ph.D.
Plant Sciences

Strawberry is an economically important crop whose production scale heavily depends on many factors. Traditional breeding methods for improving traits to combat fruit losses are difficult and time consuming; therefore, genetic transformation methods are possible for introducing beneficial genes to improve yield. Previous research established successful protocols using antibiotic selection agents; however, there are limited publications and they contain long regeneration times. Transformation protocols using different plant selectable marker genes allows pyramiding of advantageous traits because a desired trait can be introduced using one selectable marker; then the transgenic line can be re-transformed with another trait using a second selectable marker. To test the efficiency of two selectable markers, three Agrobacterium-mediated transformation protocols were used. For each protocol, the cultivar Camarosa underwent transformation with three constructs. One contained the DELLA-BZR1 gene and the 35s:hpt selectable marker conferring resistance to the antibiotic hygromycin. Another contained the DELLA-PIN1 gene and the nos:nptii selectable marker conferring resistance to the antibiotic kanamycin. The control contained the fluorescent marker gene DsRed and the nos:nptii selectable marker. Developing efficient transformation protocols, while also optimizing for multiple selection agents is critical in improving research and finding commercially important traits on a quicker time scale.

Total Protein Stain for Western Blotting: Ponceau Vs. Fast Green

Jennifer Morales Salazar
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MED: Physiology & Membrane Biol

Western blotting is a technique used to detect target proteins on nitrocellulose or polyvinylidene difluoride membranes using specific antibodies. Proteins of interest are usually detected by a signal when the membrane is imaged. This information is then analyzed and quantified to determine how proteins of interest responded to a particular experiment. In this western-blotting process, we can normalize the process by utilizing total protein staining or housekeeping proteins. In this normalization process, ponceau is usually the preferred reversible total protein stain. In our study, we investigated whether another total protein stain known as fast green, can be utilized as a substitute for ponceau. Our preliminary data suggests that fast green, although not more sensitive than coomassie stain, is advantageous to use because it stains membranes for longer periods of time. The fast green allows for a greater window of time to image the membrane. Additionally, the fast green stain allows for proteins of interest to be viewed under fluorescence. A potential disadvantage to utilizing fast green stains is that the membrane takes longer to detstain. Ultimately, the goal of this project is to determine whether fast-green is a viable alternative to ponceau.

The Role of Fasciclin IIs C Terminus in Development of the Drosophila Neuromuscular Junction Synapse

Cliff Moran
Sponsor: Karen Zito, Ph.D.
Neuro Physio & Behavior

Proper development of synaptic connections is essential for neuronal circuit function. Cell adhesion molecules (CAMs) play integral roles in the establishment and maturation of these connections. Fasciclin II is a CAM known to localize at the Drosophila neuromuscular junction (NMJ), a glutamatergic synapse. Fasciclin II shares similar structure and function with the mammalian Neural Cell Adhesion Molecule, a protein which when mutated increases the risk for neuropsychiatric disorders. Currently I am investigating the role of the C terminus of Fasciclin II in Drosophila NMJ development. CRISPR-Cas9 gene editing has been utilized to induce mutations in the Fasciclin II gene. I am screening CRISPR-Cas9 mutant Drosophila lines to identity mutations at the Fasciclin II C terminus, which is important for its protein interactions and localization to the subsynaptic reticulum (SSR), a specialized postsynaptic membrane of the NMJ synapse. I will then analyze several proteins, including Discs large (DLG), known to reside in the SSR. Using immunohistochemistry, fluorescence microscopy, and quantitative image analysis I will study the localization and relative abundance of these proteins at the NMJs of Fasciclin II mutants. Through this we hope to elucidate the role of the C terminus of Fasciclin II in the development of the NMJ.

Influence of N-donor Ligands on the Geometry of Six-coordinate Ruthenium (II) Complexes

Merissa Morey
Sponsor: Alan Balch, Ph.D.
Chemistry

This project studies ligand exchange on the ruthenium (II) metal center, involving swapping one or more phosphines on the metal center for amine or hydrazine ligands. Ruthenium complexes are of interest to inorganic chemists as a more affordable alternative to rhodium complexes for the purpose of catalysis. Luminescent ruthenium amines also have application in sensing and biological imaging. Penta-coordinate ruthenium (II) centers are typically unstable, fluxional and air-sensitive, having an unsaturated coordination sphere. The tunability of exact stereochemistry when going from these pentacoordinate complexes to six-coordinate complexes is not predictable so far due to formation of multiple isomers in solution form, of which certain isomers crystallize under specific conditions. Thus, we have been studying the formation of six-coordinate complexes from a penta-coordinate starting material in order to better understand the ligand exchange mechanism and factors controlling stereochemistry. Structural evidence shows two instances of ruthenium-catalyzed rearrangement of ligand, and some instances of unusual geometry around the metal center that defies steric predictions.

Methods to Assess Postural Responses to Unexpected Tilting Perturbations

Joseph Morrison
Sponsor: Karen Moxon, Ph.D.
Biomedical Engineering

Understanding how animals maintain posture in response to postural perturbations is important for understanding how the nervous system maintains postural control. Previous studies used rabbits and cats to study the impact of neurological injury or disease on that control. Rats are an excellent model to test therapeutic interventions after spinal cord injury (SCI), however, little is known about how rats respond to postural perturbations. To that end, the current study is investigating the effect of unexpected perturbations on postural control by measuring changes in the center of pressure. Three six-axis force-torque sensors were embedded in a platform that could tilt in one plane for varying amplitudes and durations. When a rat was placed on the platform such that the tilt occurred in the lateral plane, ground reaction forces (GFRs) were recorded. The GFRs were used to calculate changes in the center of pressure as the animal worked to maintain its balance during tilts. Changes in the center of pressure will be used to identify strategies the animal uses to maintain balance in response to the tilt. Future studies will assess the impact of SCI and different therapeutic interventions on this postural control.

Effect of Prior Forage Experience on Response to Novel Feed in Dairy Calves

Chelsea Morrow
Sponsor: Cassandra Tucker, Ph.D.
Animal Science

In the United States, dairy calves are typically not offered forage until weaning from milk at 8-12 weeks of age. Cattle appear motivated to consume forage prior to this, suggesting current management practices may be compromising calf welfare. Introducing forage at weaning may additionally compound stress in calves as they must rapidly adapt to multiple diet changes. Our objective is to determine if early-life access to hay allows for better adaptation to novel forage at weaning, and whether this access is a behavioral need in dairy calves. Twenty-seven Holstein calves were either fed a standard diet of milk and grain (Control) or given additional hay from birth (Hay). On d 50, calves were recorded for 30 minutes to measure their behavioral response to the introduction of a novel forage. We hypothesize that Control calves will show more neophobia evidenced by a longer latency to approach feed and more startle responses compared to Hay calves. We also anticipate that if calves have a behavioral need to consume forage from a young age, then Control calves will spend more time eating novel forage than Hay calves to compensate for prior deprivation.

Inducible Stress Tolerance in Chinook Salmon, Oncorhynchus tshawytscha, Fry

Gabriella Mukai
Sponsor: Anne Todgham, Ph.D.
Animal Science

Early life stage salmon often experience elevated temperatures and hypoxia (i.e. low dissolved oxygen levels) during their development in gravel nests called redds, with the frequency increasing due to climate change. Warming and hypoxia are both known to affect the survival and physiological performance of salmon during development. One mechanism that organisms can use to enhance stress tolerance over short time scales is called inducible stress tolerance (IST). IST occurs when exposure to a preliminary stressor enhances the organism's capacity to tolerate a subsequent more severe stressor. IST can be conferred between homologous (hypoxia + hypoxia) and heterologous (heat + hypoxia) stressors. Hypoxia-inducible factor-1? (HIF-1?) is a transcription factor that regulates a number of cellular pathways to increase hypoxia tolerance in fishes. This project seeks to understand the role of HIF-1? in IST in Chinook salmon fry. Specifically, we were interested in determining how a preliminary heat or hypoxic stressor may affect HIF-1? mRNA levels and whether increased HIF-1? expression is correlated with improved hypoxia tolerance.

Comparison of Asynchronous Telepsychiatry Alongside Synchronous Telepsychiatry in Skilled Nursing Facilities

Nidhi Mundada
Sponsor: Glen Xiong, M.D.
MED: Psychiatry & Behav Sci

Access to psychiatric consultations is a critical problem in Skilled Nursing Facilities (SNFs) who have patients who have end-of-life and chronic care needs. Despite the availability of Synchronous Telepsychiatry (STP), which are consultations done through a videoconferencing, it is underutilized due to administrative barriers. This study observes patients consulted through Asynchronous Telepsychiatry (ATP) which utilizes recorded video that is available for the psychiatrist to review, which allows for a more timely and flexible delivery of consultations. ATP is patient-centered, because facility staff and family members participate actively in the interviewing processes. In our on-going, large scale comparative study of ATP and STP patients, we are collecting data from 250 patients at 6 different time points. In this poster, we reviewed 60 patients who have completed all 6 time points and found both ATP and STP lead to reductions of inappropriate antipsychotic medication usage and therefore improved patient safety. Like our 2015 pilot study, our hypothesis is that ATP is as clinically effective as STP but is more accessible, administratively simple and cost-effective. By addressing psychiatric symptoms that would otherwise be untreated until emergency or inpatient treatment is needed, ATP may improve health care quality and SNF residents' quality-of-life.

The Effect of Exercise Therapy on Locomotor Recovery after Incomplete Spinal Cord Injury

Mariah Mundt
Sponsor: Karen Moxon, Ph.D.
Biomedical Engineering

Approximately 17,000 new cases of spinal cord injury (SCI) emerge every year in the United States, however few treatments exist for this debilitating condition. Previous research in both humans and animal models showed that exercise therapy is an important intervention following a severe SCI, but limited information is available on the benefits of exercise after moderate injuries that do not result in complete paralysis. To assess this, a subset of animals were given five weeks of treadmill exercise therapy following a mid-thoracic spinal cord contusion that impaired lower limb coordination during locomotion. Recovery of lower limb coordination in the exercise therapy group was compared to that of a group that received a similar injury and was handled a similar amount of time, but not given treadmill therapy. Results show that exercised animals recovered a higher degree of weight supported stepping and limb coordination than non-exercised animals. This finding highlights the importance of exercise therapy for the treatment of SCI and lays the groundwork for future studies that investigate the combination of exercise with other therapeutic interventions after SCI.

Análisis Sobre las Perspectivas entre los Migrantes Centroamericanos, México, y los Estados Unidos de la Caravana del 2018

Yaneli Munoz Lule
Sponsor: Robert Irwin, Ph.D.
Spanish & Portuguese

Esta investigación sobre la caravan que salió de Honduras en octubre del año 2018 se enfoca en Guatemala, frontera Guatemala-México, México, y frontera México-Estados Unidos. Esta investigación indaga sobre el viaje de los centroamericanos y la estancia de los centroamericanos en la frontera. En esta investigación, cuyo objetivo es analizar las diferentes- a veces contradictorias- reputaciones de los migrantes de la caravana, se presenta evidencias de las redes sociales, periódicos, revistas, noticieros en México y Estados Unidos, declaraciones de políticos de estas dos naciones, estudios académicos, y materiales audiovisuales.Se comparará la perspectiva de la caravana entre los medios de México y Estados Unidos, medios conservadores y medios liberales como BBC, Breitbart, El País, y NY Times. También se analizarán materiales audiovisuales como el documental La Bestia y el proyecto de narrativas digitales (testimoniales) Humanizando la Deportación, y la retórica de políticos polémicos como el presidente de Estados Unidos Donald Trump, el alcalde de Tijuana Juan Manuel Gastélum, el presidente de México Andrés Manuel López Obrador, y ex presidente de México Enrique Peña Nieto. A través de esta investigación se analizaran las imágenes de los migrantes que predominan en estas diferentes fuentes y las diferentes perspectivas de la caravana.

Persiguiendo el Sueño Americano: Los Riesgos que Enfrentan los Centroamericanos en su Transcurso por México por Tren y Caravanas.

Yazmin Munoz Lule
Sponsor: Robert Irwin, Ph.D.
Spanish & Portuguese

La tesis adjunta examina los riesgos, necesidades, e incertidumbres por los cuales los centroamericanos pasan al atravesar México rumbo a EEUU. Los dos patrones migratorios en los que me enfocaré son la migración por caravana y por el tren conocido como la Bestia. A través de los años, la manera más común de migración por los centroamericanos, por México, ha sido la Bestia. Sin embargo, las caravanas han surgido recientemente como otra opción de viajar hacia el norte del país. Las caravanas ofrecen una forma para que los migrantes se protejan entre sí a lo largo de su viaje para evitar asaltos, asesinatos, secuestros, violaciones, accidentes y robos por parte de las autoridades y particulares. La violencia y amenazas por parte de las pandillas junto con la falta de apoyo por las autoridades y gobierno han motivado a miles de centroamericanos a salir de sus hogares y arriesgar sus vidas al atravesar México. Esta tesis explica más a fondo los peligros que los centroamericanos enfrentan en México al viajar por el país y las zonas fronterizas entre México-Guatemala y México-EEUU. Adicionalmente identifica las ayudas y peligros que encuentran en el camino para entender mejor la experiencia de los migrantes.

HEK-Blue Assay-based in vitro Quantification of Fe2O3-R848 Complex Encapsulated into HEVNP

Konomi Murata
Sponsor: R holland Cheng, Ph.D.
Molecular & Cellular Bio

A resiquimod (R848) – an agonist of TLR7/TLR8 (Toll-Like-Receptors) – has been shown to activate immune cells and is a potential anti-cancer therapy drug. A major limitation of R848 is non-specific delivery and various side-effects. To increase the efficacy of R848 and to ultimately reduce the side effects, we used Hepatitis E viral nanoparticles (HEVNP) to encapsulate the R848 and use HEVNP's surface functionalization capacity to enable targeted delivery. Since R848 is poorly soluble in water, we utilized DMSO to dissolve it and rapidly entrap the drug around 10 nm ferrite oxide nanoparticles. The R848-Fe2O3 was then encapsulated into the internal cavity of HEVNP. To evaluate the encapsulation, we employed HEK-Blue-hTLR7 assay and designed a series of experiments to optimize the conditions. The preliminary results indicate that the R848 molecules bind to TLR7 on HEK-Blue cells and induce the expression of secreted embryonic alkaline phosphatase (SEAP) which is detected by Quanti-Blue substrates.

Eelgrass Wasting Disease in Bodega Bay, CA: Seasonal Variation in Severity with Implications for Plant Defenses and Herbivory

Naomi Murray
Sponsor: John Stachowicz, Ph.D.
Evolution & Ecology

Eelgrass wasting disease has been responsible for multiple large-scale die offs of eelgrass (Zostera marina) over the last century, compromising critical habitat for fishes and invertebrates. Despite decades of research, little is known about the ecology of the disease, including how seasonal variation in severity impacts eelgrass and its epifaunal community. This study established a baseline measure of the prevalence of wasting disease in Bodega Bay and investigated whether infection made plants more susceptible to herbivory. I found disease virtually absent in early summer but peaking at more than 20% leaf tissue cover by midsummer. I also conducted a series of feeding trials offering herbivorous amphipod Ampithoe valida a choice between diseased and healthy plant tissue, and measuring chemical and structural plant traits that may drive differential consumption. While diseased plants had higher phenolic acid content, lower C:N ratio, and similar leaf toughness as healthy plants, A. valida preferred to eat diseased rather than healthy tissue. Untangling this relationship between herbivores and disease may provide additional understanding of the temporal cycling of wasting disease; herbivore consumption likely affects community-level distribution of the pathogen. Knowledge of such patterns will allow us to better protect seagrass ecosystems in a changing climate.

Behind the Veil

Layla Mustafa
Sponsor: Suad Joseph, Ph.D.
Anthropology

For this project related to our research internship in the Lab of Dr. Suad Joseph on “The New York Times Media Project,” we address how the term “veil” is portrayed in the New York Times between 1952 and 1962, the years of Algerian war for independence. We paired the term “veil” with “Algeria" to focus our search on the specific region. Our sample articles, searched through the Pro-Quest platform used in Dr. Joseph’s lab, employ the research methodology conducted in Joseph Lab Media Project--media content analysis. Based on documented stories of unveiling ceremonies in Algeria, we argue that the New York Times represented the veil as an oppressive symbol. The “veil” is a symbol which may help us understand the predispositions New York Times authors hold and have encouraged their readers. This research is important to aid in understanding the continuous modern-day politics and debates over the Arab region.

Development of a Hydrogel Bioreactor for Cost-Effective Extraction of BChE from Transgenic Rice Cells

Maya Mysore
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The global bioprinting market is expected to reach over 4.1 billion USD in value by 2026. This explosion of the bioprinting industry includes using techniques like encapsulation of cells in alginate-based hydrogels. These hydrogels can be used as bioreactors for both cell growth and simplified protein extraction. Our team uses hydrogels with rice cells that were engineered to produce tetrameric BChE, a complex human serine hydrolase enzyme that provides protection against organophosphorus poisoning. This particular form of BChE has previously only been found in expired human blood plasma and costs over $10,000 to produce per treatment. By combining hydrogel encapsulation technology, a low-cost bioprinter, and transgenic rice cells, our group is working to develop a method of extraction that reduces the cost of producing this protein. To determine if hydrogel encapsulation is an effective way to extract BChE from transgenic rice cells, we ran repeated Ellman assays to quantify the levels of BChE present in solution over time. To determine if this would be a viable long-term solution to reduce extraction costs from the process of purification, we ran TTC cell viability assays to determine how prolonged exposure to gel affects cell growth and viability.

Anomalous Trends in Electrochemical Detection of Nucleic Acids in Nanostructures

Sachit Nagella
Sponsor: Erkin Seker, Ph.D.
Elect & Comp Engr

Molecular diagnostics have significantly advanced the early detection of diseases, where electrochemical sensing of biomarkers has shown considerable promise. The performance is evaluated by percent signal suppression (% ss), which indicates the change in current after hybridization. This is generally due to more redox molecules (e.g., methylene blue) associating with the probe DNA bases in the single-strand form than the double-strand form upon hybridization with the target nucleic acid. Nanostructured electrodes generally enhance electrochemical sensor performance from increased number of capture probes per electrode volume and nanoscale transport phenomena. We employ nanoporous gold as a model electrode material to study the influence of probe immobilization solution concentration on sensor performance and the underlying mechanisms. Unlike planar gold electrodes, where % ss reaches a steady state with increasing concentration, the % ss displays peak performance at certain grafting solution concentrations followed by deterioration and possibly an unexpected case of increased charge transfer upon hybridization. Fluorometric assessments of electrochemically desorbed nucleic acids for different electrode morphologies reveal that a significant amount of DNA molecules remains within the nanopores. Analysis of electrochemical signals suggests the unbound nucleic acids may be altering the modes of methylene blue interactions with them and the electrode.

Investigating the changes of Nrf2 expression through DNA affinity immunoblotting (DAI)

Evelyn Navar
Sponsor: Anne Knowlton, M.D.
MED: Int Med Cardiology (sac)

Nrf2 is a transcription factor best known for regulating the expression of antioxidant and detoxification genes. Understanding the role of Nrf2 in cardiovascular disease opens new opportunities to understand the mechanisms of diseases such as atherosclerosis, ischemia, reperfusion, cardiac hypertrophy, and heart failure. In addition to antioxidant and detoxification genes, Nrf2 has been found to regulate genes participating in cell signaling and transcription, suggesting that Nrf2 governs damage resistance as well as wound repair. At the cellular level, an initial episode of ischemia causes an increase of reactive oxygen species (ROS). For this study, cardiac myocytes were treated with hydrogen peroxide and TNF-alpha. This exposure mimics cell injury and prompts inflammatory responses. Based on this, we hypothesize that Nrf2 expression is upregulated when exposed to ROS. We use the DNA affinity immunoblotting (DAI) method to measure the activity of multiple sequence-specific DNA-binding proteins using a cardiac cell line. DAI can detect modified forms of DNA-binding proteins and their interacting proteins in complex with DNA. We will investigate other components of the Nrf2 cascade to observe changes in gene regulation when exposed to ROS. This study will also focus on identifying mechanisms altering localization after ROS treatments.

TRPM8 Activity is Necessary for Motor Neuron Survival in *Xenopus* laevis Embryos Raised at Cold Temperature

Andrea Navarrete Vargas
Sponsor: Laura Borodinsky, Ph.D.
MED: Physiology & Membrane Biol

Motor neuron degeneration is a characteristic of neurodegenerative disorders such as Amyotrophic Lateral Sclerosis (ALS). Previous studies demonstrated that Xenopus laevis grown at cold temperature exhibit higher number of motor neurons than siblings grown at warm temperatures. This cold-temperature-dependent increase in motor neurons correlates with a decrease in motor neuron programmed cell death, apoptosis. We hypothesize that the cold-sensitive channel TRPM8 regulates the rate of motor neuron apoptosis in Xenopus laevis spinal cord neurons during development. To test this hypothesis, two-cell stage embryos were injected with either TRPM8 or control morpholino and then raised at 16?. Immunohistochemistry was used to detect expression of Hb9, a motor neuron transcription factor, and for TUNEL assay, which fluorescently detects apoptotic cells. TRPM8 knockdown resulted in an increase of apoptotic motor neurons shown by an increased percent of HB9 positive cells that are also TUNEL positive from a mean of 1 ± 1% in the control group to 34 ± 7% in the TRPM8 morpholino group. These data support my hypothesis that TRPM8 is necessary for the prevention of apoptosis of spinal cord neurons, specifically motor neurons, in animals raised at cold temperature.

Mixed vs Categorized Problem-solving in chemistry education

Marilyn Navarrete-Pleitez
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Practice problems given to students in the form of worksheets or other mediums are often categorized; they are grouped by the unit of study (ex. stoichiometry problems in a 'Stoichiometry' section). However, tests are typically not grouped by unit (ex. A stoichiometry problem followed by a balancing equation problem). Our objective was to evaluate student test performance when they were given either mixed review problems without unit identifiers, or categorized problems with unit identifiers. Students enrolled in the general chemistry 2b winter course at the University of California-Davis attended three problem-solving review sessions in which they solved either mixed or categorized practice problems, and were evaluated on their content knowledge. Evaluations consisted of a pre-test during the first session, and post-tests after the end of each problem-solving session, with each test containing only long answer questions. Students were encouraged to write out their thought process during the review session and their work on practice problems was collected after every session. Students were not told the results of the pre- or post-tests but were given the answers to the practice problems after the session was over.

Vertical Thrust Stand for Hot-Fire Testing Mid-Power Hybrid Rocket Motors

Gloria Navarro
Sponsor: Lynne Arcangel, M.A.
Graduate Division

Rocket propulsion systems (RPS) are integral to space launch, missile systems, and spacecraft maneuverability. Research and educational activities at the University of California, Los Angeles are underway to improve rocket propulsion performance and educating the next generation of engineers. Typical "hot-fire" experiments conducted in the Mojave Desert are used to ensure a safe and reliable RPS. These time-consuming, expensive remote tests could be conducted on campus with small-scale engines in a controlled environment where more campus preparation can be done. With this motivation, a portable hybrid rocket thrust stand capable of supporting small-scale rocket motors of 100-lbf thrust has been designed using SOLIDWORKS 2018, and fabricated, including a support for the rocket motor, a nitrous oxide bottle inverter, and a remotely controlled switchboard. The manufactured thrust stand will allow students to perform hot fire tests on campus at UCLA and/or be readily transported for more time-efficient testing in the desert . The stand serves as storage and additional transport for essential tools needed to execute these tests. This system provides faster feedback, increased controlled preparation, and low turnaround time thereby enabling students and researchers to reach the test-phase of their projects more quickly, accelerating project-based aerospace education and research.

Elucidating Metal Binding Interactions with a Peptide Hormone, C-peptide

Ryan Neil
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

The connecting peptide (C-peptide) is a hormone that is co-released in equal amounts with insulin in response to an elevation in blood sugar. Although initially thought to be biologically inert, recent studies have revealed that C-peptide plays a beneficial role in ameliorating vasculopathies and kidney dysfunction. Interestingly, studies by our lab and others have observed that C-peptide function may depend on bioavailable metals, particularly Cu(II) and Zn(II). However, little is known about the chemical nature of the interactions, hindering advances in its therapeutic applications. To this end, we are elucidating the relationship between C-peptide and these metal ions through various spectroscopic techniques. We have found that Cu(II) and Zn(II) bind to C-peptide at specific residues, particularly glutamate and aspartate, and that Cu(II) is able to displace Zn(II) for C-peptide binding. These results suggest potential roles in metal-mediated regulation of peptides and hormones, and point to future roles in drug development.

RAD51: A Promising and Novel Target for Anticancer Therapy

Nina Nelson
Sponsor: Jeremy Chien, Ph.D.
MED: Biochem & Molecular Med

High Grade Serous Ovarian cancer is the most lethal gynecological malignancy, which necessitates further research into potential therapy targets. RAD51 is a critical recombinase and necessary component for a functional homologous recombination (HR) DNA repair pathway. The RAD51 protein binds to DNA at the site of a break and encases it in a protein sheath, which is an essential step in the repair process. Because of its integral role in double strand break repair, an abnormal RAD51 protein may contribute to the mutation of an oncogene. By selectively degrading RAD51 in tumor tissue with targeted therapy we will be able to induce HR deficiency, which can be combined with PARP inhibitors to achieve tumor-specific therapeutic outcomes. RAD51-targeting molecules would be excellent for use as single agents or in combination with conventional chemotherapy. To determine the extent to which ovarian cancer cells exhibit acquired dependency of RAD51, we assessed RAD51 expression in three ovarian cancer cell lines. We then used siRNA gene silencing to knock down RAD51 expression in these cell lines and determined cell viability using the Cell-TiterGlo assay. These results suggest RAD51 targeting produces beneficial therapeutic effects in ovarian cancer.

Modeling Algae Productivity for Use in Outer Space

Adele Nemer
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Due to its abundance and photosynthetic capability, algae produces over half of the oxygen in the Earth's atmosphere. It has been proposed that unicellular microalgae can be used in bioreactors to provide a continuous supply of oxygen in space; however, there are countless factors influencing the productivity and feasibility of this endeavor. To account for all variables and to determine optimal conditions, a group of researchers in a FYS-CURE class compiled existing data from an ongoing literature search and utilized Stella Online modeling software while conducting laboratory trials of algal growth. Students focused on variables including algal species, nutrient types and levels, light types and cycles, temperature, carbon dioxide input, gravitational effects, pH, and the required oxygen output to ascertain an optimal model. Most variables are complex and intricately connected, so the overall goal was focused on making a fully comprehensive online model of the system in order to run trials at different conditions to maximize efficiency. This research is fundamental in the development of feasible long-term space travel, and may also have applications on Earth as a carbon-sequestering system that simultaneously enriches our atmosphere with oxygen.

The Impacts of Law Enforcement and Ordinances on Homeless Individuals in Sacramento

Chase Newell
Sponsor: William Mccarthy, Ph.D.
Sociology

This project centers on how homeless individuals are impacted by local anti-camping laws and ordinances in Sacramento. This question is not easily answered without research, as some areas have rabid enforcement of anti-camping laws, and other quality of life laws, while other places have significantly milder enforcement. Ordinances vary from place to place, and even throughout parts of the same city. Studies have been conducted in numerous cities, including San Francisco, Los Angeles, Seattle, and Austin. However, Sacramento presents a gap in the literature. Studying Sacramento entails exploring how laws and ordinances influence the lives of homeless individuals in one particular, current context. I will look in depth at how homeless individuals react emotionally and behaviourally to local laws and ordinances, and their enforcement via interviews. The research also follows an ethnographic tradition, as I visited a shelter which many homeless individuals cycle through, to gain entry into the Sacramento homeless population.

Effects of After-ripening Storage Temperature and Length on Germination of California Jewelflowers

Adrianna Ng
Sponsor: Johanna Schmitt, Ph.D.
Evolution & Ecology

Germinating under favorable conditions is critical to plant success. After-ripening is the storage of a seed in warm, dry conditions after being released from the parent plant. This stage of development is especially useful when seeds are released in unfavorable germination conditions, as they will then enter dormancy until more favorable conditions present themselves. Two genera of plants, Streptanthus and Caulanthus, within the Brassicaceae family were investigated to identify the effects of after-ripening length and storage temperature on germination. To carry this out, seven species of Streptanthus and four species of Caulanthus seeds were harvested from field sites and then divided into 4, 8, and 12 week storages at 25°C and 35°C. The seeds were then hydrated and plated for germination surveys after their given after-ripening storage period. The proportion of seeds that germinated within each species tended to increase as storage time increased. Moreover, a higher after-ripening storage temperature also led to increased germination. As the climate warms, this could potentially mean higher germination rates for California jewelflowers.

CRISPR Genome Editing Suppresses VEGFa Protein Production

Taylor Ngo
Sponsor: Glenn Yiu, M.D.,Ph.D.
MED: Eye Center

Current treatments of neovascular age-related macular degeneration (nAMD) target vascular endothelial growth factor (VEGF) through frequent, costly, and invasive intravitreal injections of anti-VEGF pharmacotherapies. For permanent suppression of VEGF, we conducted a pre-clinical study using CRISPR genome editing technology with programmable Cas9 endonuclease to induce gRNA-specific genomic disruption of VEGF-A in mice. Here, we compare VEGF-A production between S.pyogenes Cas9 (SpCas9) programmed with paired-gRNA and single-gRNA both in cell line and mouse retina. After selecting gRNAs targeting conserved sequences in both mouse and human Vegfa genes, vectors expressing SpCas9 and the corresponding gRNAs were transfected into human HEK293T cells. These vectors were also packaged into adeno-associated virus 8 (AAV8) and injected into the subretinal space of mouse eyes. Following protein extraction, we quantified VEGF-A protein with ELISA and found that paired gRNAs yielded greater suppression of VEGF-A than the single gRNA both in vitro and in vivo. In HEK293T cells, the paired gRNAs reduced VEGFa production by 24.01%, compared to 16.57% from single gRNA. In mouse eyes, the paired gRNAs reduced VEGFa production by 36.2%, compared to 23.1% from single gRNA. Our findings provide greater insight into optimizing treatments of nAMD through genome editing techniques.

The Significance of Implementing a Narrative Medicine Approach at the Knights Landing One Health Center (KLOHC)

Brandon Nguyen
Sponsor: Natalia Deeb Sossa, Ph.D.
Chicano Studies

The Knights Landing One Health Center (KLOHC) is a student-run clinic that provides “One Health” services to the rural and migrant residents in Knights Landing. As a continuum of community engagement, a Narrative Medicine (NM) approach was implemented. This NM approach affects three immediate beneficiaries: the patient, the undergraduate translator, and the medical student (MS). The undergraduate translators ask three NM questions that promote open-ended responses and holistic wellness. The MSs use the following NM introduction: “I will be your doctor. So I need to know a great deal about your health, body, mind, spirit, and life. What brings you in today?” This approach was quantitatively evaluated using scale ratings which were designed to (1) determine if the NM questions helped alleviate anxiety; (2) determine whether the NM questions and introductions revealed social history; (3) determine if the approach implementation reduces waiting time. Statistical analysis on the scale ratings are forthcoming. Qualitative results indicate that patients discussed the following: disabilities, family trauma, past medications, aging, health education, nutritional habits, mental health, and legal status. Similarly, patient interactions encouraged volunteers to reflect on their own narratives. Through this approach, patients lead their healthcare conversation to maintain proper, predetermined treatments.

Investigating the Interactive Effects of Diet and Temperature on Omnivorous Temperate Fish

Tina Nguyen
Sponsor: Lynne Arcangel, M.A.
Graduate Division

Fish are experiencing rising average temperatures in the ocean in addition to higher exposure to extreme temperatures daily and seasonally. Species that can adapt to these temperature changes more quickly have an advantage, and we predict that their diets can influence their ability to acclimate, or respond physiologically to new conditions. Fish consumption tends to be more carnivorous towards the poles and herbivorous towards the equator, suggesting that diet may impact the way fish cope with temperature changes. Opaleye, a fish species native to Santa Barbara waters, are an ideal model to study diet effects on thermal acclimation due to their omnivorous diet and the fact that they have been shown to change their diet with environmental temperature in the wild. Using sprinting performance as a proxy of fitness, we test the interactive effects of diet strategy and temperature on juvenile opaleye. We hypothesized that herbivorous and omnivorous fish performance would be greater than that of carnivorous fish in warmer temperatures, while in colder temperatures, carnivorous diets would confer greater performance. If this is true, it would suggest that fish and other ectotherms may be able to alter their diet to respond to temperature stress.

Using Laboratory Observation Protocol to Analyze Teaching Practices in Chemistry Laboratories

Angela Nguyen
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Beginning in Fall 2017, the Chemistry Department at UC Davis started a pilot program through which undergraduate teaching assistants, formally known as Emerging Scholars (ES), have been working with graduate teaching assistants (TA) in laboratory settings. In order to observe and study the differences in student interactions with the TAs and the ESs, every TA and ES was asked to audio record their conversations during two lab sessions. After the audio data were collected, they were first transcribed, and student interactions with the lab instructors were coded using Laboratory Observation Protocol for Undergraduate STEM (LOPUS). Findings of this study will reveal whether students are more comfortable approaching TAs or ESs, and how the teaching styles may vary between the two lab instructors. Student inquiries and TA's or ES's responses will be carefully examined to better understand the instructional styles in the labs. These observations and analyses will reveal the efficacy of the Emerging Scholars program and provide the guidelines to enhance student learning experiences.

Electrophysiological Evidence for the Expression of the Neurokinin-1 Receptor in RVM ON-Cells

Amanda Nguyen
Sponsor: Earl Carstens, Ph.D.
Neuro Physio & Behavior

The rostral ventromedial medulla (RVM) is an area of the brainstem important for descending modulation of pain. Within the RVM, a class of neurons called ON-cells have been shown to facilitate spinal pain transmission. Previous studies have shown that RVM ON cells are excited by local injection of the neuropeptide substance P (SP), the cognate ligand of the neurokinin-1 receptor (NK-1R). We hypothesize that RVM ON cells express the NK-1R. To test this, we conducted pharmacological and electrophysiological experiments. Using a microelectrode and microinjection cannula, ON cells were identified and either SP or saline was injected locally. After injection with SP, ON cells showed significantly higher mean normalized firing rates compared to saline injections. To directly activate NK-1R expressing neurons, channel rhodopsin (ChR2) was induced specifically into NK-1R neurons as verified by immunofluorescence staining. We identified ChR2-expressing neurons that responded to blue light delivered through an optic fiber. Light-sensitive neurons were functionally identified as ON cells based on their increase in firing just prior to pinch-evoked hindlimb withdrawal. These findings support the hypothesis that NK1-R-expressing RVM neurons are ON cells.

Building an App to Promote a Sense of Belonging for UCD Students

Ninh Nguyen
Sponsor: Kali James, Ph.D.
Anr Human Ecology

The purpose of this study is to understand what struggles students may face in their transition to college and attempt to reduce them over time. Belonging, feelings of inclusion, is an important aspect of students succeeding. When students feel a lack of belonging, they may have difficulty adjusting to their new environment. We aim to address students' struggles by providing them with "belonging stories", stories of how UC Davis students tackled issues and persevered. Results from focus groups indicated that students wanted to be able to access these stories at any time, even after their first year on campus. Therefore, our team is developing an app to make these stories available to all UC Davis students. We are now conducting focus groups to understand if the stories are beneficial, learn about how user-friendly our app is, and what resources students would like to see in the app. Our goal going forward is to provide an app to help students feel like they belong at UC Davis.

Development of Low-Cost and Reliable Reaction Wheel for CubeSat Attitude Control

Dzuy Nguyen
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Manufactured Reaction Wheel (MRW) component of the REALOP mission, UC Davis's first and completely undergraduate-led CubeSat mission. Reaction wheels are required by REALOP to point the satellite's visual and infrared spectrum cameras toward Earth and stabilize them to avoid motion-blur. The REALOP mission is developing low-cost and reliable reaction wheels for CubeSat application. These components are manufactured through the use of the student machine shop on campus, ensuring the cost-effectiveness and documentation of the manufacturing process. To mitigate risk of failure, reaction wheel prototypes will undergo extensive testing to verify that the design withstands launch loads and operates in the vacuum and temperature ranges of low Earth orbit for extended periods of time. Costs of commercial CubeSat reaction wheels typically exceed total budgets for university missions; successful demonstration and detailed documentation of REALOP's reaction wheel will provide university missions with a low-cost and reliable design, lowering barriers to entry to space and improving mission success.

Defining the Interaction Between the Unconventional Cell Cycle Inhibitor, Cyclin G2, Protein Phosphatase 2A and ß-catenin in Brain Tissues and Post-mitotic Neurons

Eric Nguyen
Sponsor: Mary Horne, Ph.D.
MED: Pharmacology

Cyclin G2 (CycG2) is an unconventional PP2A-phosphatase-associated cyclin homolog that inhibits cellular proliferation. Interestingly, CycG2 gene (CCNG2) transcripts are substantially increased as cerebellar granule cell (GC) neuron precursors exit the cell cycle and differentiate into neurons, and CycG2 protein expression is abundant in adult hippocampal and cerebellar tissues and neurons. Having previously shown that cerebellar CycG2 forms active PP2A phosphatase complexes containing PP2A/B' and C subunits, we examined whether CycG2 interacts with other PP2A-binding partners, including ß-catenin. Immunoprecipitation and pulldown experiments provided compelling evidence that ß-catenin directly associates with CycG2, binding just N-terminal to the PP2A/C and B' subunit interaction sites in CycG2. To more precisely define binding sites and binding affinity between ß-catenin and CycG2, we used fluorescence polarization peptide binding assays, which utilizes the fixed-rotation induced fluorescence property of small, labeled CycG2 peptides upon binding with larger, more immobile target proteins. We present our analysis of CycG2 interactions with PP2A and ß-catenin/N-cadherin complexes and other potential binding partners. Our ongoing studies investigate the consequences of CRISPR mediated CycG2 knockout on neuronal, synaptic, and dendritic morphology and ß-catenin-associated complexes.

Wearable Posture Support for Surgeons

Bopan Ni
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Many medical workers including surgeons develop pain due to standing with poor posture. Lower back, neck and shoulders are the primary body parts affected by muscle fatigue. Our goal is to design a product that supports surgeons' backs while they are performing surgery for hours continuously. We conducted in-depth user research by interviewing eight surgeons about their needs regarding posture and pain during long operations. Our findings show that a potential wearable solution has to be sterilizable, comfortable, and unobtrusive enough to not interfere with surgeons' operations. To meet these constraints, we are developing a wearable product that provides muscular and skeletal support to alleviate pain using innovative materials such as shape memory alloys, polymers, and rapid fabrication techniques such as SLA 3D printing and lazer metal 3D printing. We hope that the product will eventually impact fields beyond medicine, supporting many different individuals with bad posture and back pain.

Human-Centered Design for Sustainable Menstrual Hygiene

Jolee Nieberding-Swanberg
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

The majority of American menstruators address their period health with disposable pads and tampons. A reusable alternative is a menstrual cup which is worn inside the vaginal canal to catch, instead of absorb, blood. Cups can reduce landfill waste, provide longer durations of leakage protection, and save costs in the long-run. However, they are still overshadowed in popularity due to challenges associated with integrating the product into everyday life. Our project applies human-centered design to develop novel menstrual cups that prioritize accessibility and efficacy for users. This includes identifying factors for or against adoption of menstrual cups including environmental impact, ease of usage, cultural norms, financial incentives, health outcomes, and aesthetics. We achieve this goal by interviewing menstruators who range in their experience with, and enthusiasm for, reusable period products. We also analyze feedback on menstrual cup models available on the market. Our findings indicate that barriers to usage may include the learning curve for insertion and removal of current designs, higher up-front cost compared to disposable products, and discomfort with changing cups in public facilities. Guided by these findings, we utilize digital fabrication tools to prototype novel and user friendly menstrual cups to enable more sustainable personal hygiene practices.

College Decisions and the Campus Outdoor Built Environment

Kelly Nishimura
Sponsor: Patsy Owens, M.L.A.
Human Ecology

Research has shown that campus visits play a pivotal role in shaping a student's decision in which college they decide to enroll. However, further research is needed to understand how the outdoor built environment influences these decisions. This study aims to understand the relationship between a campus outdoor built environment and a student's decision to enroll in their current institution. Specifically, I am looking to understand which physical outdoor elements students associate with influencing their college decision. These relationships will be studied through one-on-one interviews with students and more widely distributed questionnaires. Findings will identify outdoor campus environments, such as entries, main gathering areas, and landmarks, that significantly influence a student's perception of an institution and their willingness to enroll at the school. The characteristics of these environments such as presence of natural elements, activities, and use levels, will also be examined. Furthermore, this study will develop a proposed redesign of a portion of the University of California, Davis campus in response to the qualitative findings and analysis. The goal of this research project is to assist campus planners and designers in understanding how to redesign a campus' outdoor environment to increase prospective students' willingness to enroll in their school.

Design to Data for Mutants of ß-glucosidase B From *Paenibacillus polymyxa*: T36N, D150N, N245D, F397Y, and K413Q

Henrique Noro Frizzo
Sponsor: Justin Siegel, Ph.D.
MED: Biochem & Molecular Med

Predicting enzyme thermal stability and kinetic efficiency through computational methods has long been an interest in a variety of industries. This study presents the evaluation of single residue changes in the enzyme ß-glucosidase B (BglB), from Paenibacillus polymyxa. Four mutant enzymes were designed using a Rosetta based program named FoldIt to assess the effects of hydrogen bonding on the surface of the enzyme in relation to its kinetic efficiency and thermal stability. One extra mutant was designed to have a mutation that increased polarity in the hydrophobic interior of the protein to allow a comparison of mutations on the surface with mutations in the interior. It was hypothesized that more hydrogen bonding and polarity on the surface of the enzyme would result in higher thermal stability while the same changes would result in the opposite effect when made in the hydrophobic interior of the enzyme. The data was inconsistent with previous experiments and the results did not support this hypothesis. This reinforce the need for more data to allow more accurate predictions.

Exploring the Relative Contributions of DNA Topology and Sequence on R-Loop Formation

Catherine Nugent
Sponsor: Frederic Chedin, Ph.D.
Molecular & Cellular Bio

R-loops are three-stranded structures that form during transcription upon annealing of the nascent RNA with the DNA template strand. R-loops are a valuable subject of study due to their prevalence as universal structures in genomes. R-loops have been associated with important cellular functions in health and disease. Understanding the physical and chemical forces driving R-loop formation is therefore significant. Previous work shows that these structures are influenced by the local sequence and topology of the DNA template, though it is unclear to what extent each factor plays a part. The methods involved in this project include In Vitro Transcription (IVT) of a variety of plasmid constructs containing sequences known to form R-loops in the human genome. Comparing R-loop formation across sequences will allow us to determine the contribution of DNA sequence to structure formation. To measure the contribution of DNA topology, we manipulate the degree of superhelicity in the plasmids by inducing or removing supercoils in the DNA prior to performing the IVT assays. This project will allow for a better understanding of the foundations underlying R-loop formation.

Novel Bioengineering Approach for Efficient *in vivo* Fermentation Product of siRNA against PD1 and PDL-1 for Cancer Therapy

Rosally Nunez
Sponsor: Aiming Yu, Ph.D.
MED: Biochem & Molecular Med

As discovered in past research, short interfering ribonucleic acids (siRNA) can regulate gene expression via RNA interference. Therefore, siRNA can potentially serve as cancer therapeutics by blocking atypical cell growth and division. The Food and Drug Administration has found potential in siRNA as a drug by approving the siRNA Patisiran to treat Hereditary transthyretin-mediated amyloidosis (hATTR). In this study, we will be using novel bioengineering techniques to construct siRNA to target PD1 and PDL-1 genes. In normal cells, PD1 and PDL-1 act as immune checkpoint proteins that guarantee appropriate immune system activation. The binding of PDL-1, which has a high expression in tumor cells, to T-cell PD1 receptors inhibits the cytotoxic response, allowing the tumor cell to evade apoptosis. For production, Escherichia coli will be transformed and overexpressed with a plasmid incorporating our siRNA sequence with a tRNA carrier. To purify the siRNA, an anion exchange fast protein liquid chromatography (FPLC) will be performed. Purity will be confirmed with a high-performance liquid chromatography (HPLC) assay. Endotoxin level will then be verified. In the future, more assays will be done to study the potential of siRNA against PD1 and PDL-1 as a cancer therapeutic both in vitro and in vivo.

The Role of Collagen Composition and Orientation in Lateral Force Transmission with Aging

Jed Keenan Obra
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Collagen is the most abundant protein in the body and functions to provide the mechanical strength of connective tissues. In muscle, collagen fibrils function both to hold muscle fibers together and transmit force laterally between fibers. With aging, force transmission and muscle mass are reduced; however, how changes to specific collagen isoforms or the matrix orientation contribute to force loss is currently unclear. The purpose of this study is to compare lateral force transmission in young and old people with changes in specific collagen proteins and the orientation of the matrix. To study this comparison, cross-sections of the gastrocnemius muscle were taken to determine specific collagen content and fiber cross-sectional area (CSA), whereas longitudinal sections were stained with picrosirius red to determine matrix orientation. As expected, fiber CSA tended ($p = 0.1$) to decrease in the old subjects. Picrosirius red staining showed that the collagen matrix is oriented at a 22.3±3.1% angle to the fibers in young and 30.2±8.7% in old subjects. By establishing the role of specific collagen proteins during aging, we hope to better understand the relationship between the extracellular matrix and force transmission in muscle and how this relationship is modified by age.

The Effects of Molt on Innate Immunity on Chickens (*Gallus gallus domesticus)*

Marisol Ocana
Sponsor: Kirk Klasing, Ph.D.
Animal Science

For poultry, there are a variety of nutritionally costly life stages that must be balanced with the costs of the immune system. Molt is known to be expensive in terms of nutrient requirements due to metabolic costs associated with producing feathers quickly. Little is known about the relationship between molt and immunity. The objective of this study was to use chickens (Gallus gallus domesticus) to clarify the impacts of molt on nutritional investment in immunity during a challenge to the innate immune system. Four treatment groups (n = 7) were used: 1) No molt 2) No molt + LPS challenge 3) Molt and 4) Molt + LPS challenge. Chickens were shifted from a long-day schedule to a short-day schedule and administered oral thyroxine at a dose of 1.25 mg/kg of body weight. An injection of lipopolysaccharide (LPS) (1.5 mg/kg) was administered three weeks after the onset of molt. Liver, spleen and thymus samples were collected for evaluation of cytokines using qPCR. Molt status was found to significantly affect the size of both the spleen and the thymus ($p < 0.001$). The results of this research can be used toinform subsequent research on management practices that optimize immunity during molt.

Are You Looking Where You're Going? Gaze Allocation During a Navigation Recall Task

Michelle Occhipinti
Sponsor: Joy Geng, Ph.D.
Psychology

When presented with scenes, eye movement patterns change as a function of repetition and task demands. Gaze allocation during navigation is of particular importance to better understand how routes are learned and recalled in a real world environment. Prior studies largely focused on components of navigation, such as differences when walking a route versus watching a video of a route, but fail to examine how the route is being learned. To test this, eye movement data was collected while participants viewed a route through a simulated urban environment. The route was presented twice as a series of images taken from Grand Theft Auto V either in sequential or scrambled order. After viewing, participants were presented with images of the intersections from the route and asked to indicate the direction to proceed from that intersection to continue along the correct path. Analyses revealed that fixations varied across groups and repetition while learning the route, and only the group that learned the route did well on the recognition task. Specifically, when viewing images in order versus randomly, fixations are on the path rather than irrelevant objects, but when making route based decisions at test, fixations tend to be on similar scene objects.

Analyzing the Effect of Assignment Structures on Students' Problem-Solving Performance in Chemistry

Tiffany Oentoro
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

The questions in the practice assignments given to students in the form of worksheets or other formats are often grouped by chapter, topic, or concepts. There is a great emphasis on categorization. Most of the end-of-chapter problems in chemistry textbooks are organized by sections. Although this was done with the intention of helping students navigate the assignments more easily and practice in order, it is not what they are expected to do during the tests. There is a mismatch between what they practice on and how they are tested. The goal of this study is to examine the influence of the structure of the assignments on students' problem-solving performances. Two groups of students from chemistry classes will be recruited to participate in this study. Each group will have the same length of practice and identical questions with only one difference. The experimental group will have assignments with mixed questions, while the control group will have traditional assignments with the questions organized around chapters and topics. Students will complete three two-hour long sessions during the weekends. Evaluation of their progress will consist of their written thinking process and one pre-test and three post-tests, with one given after each problem-solving session.

Fundamental Groups of the Complement of Braided Surfaces

Sari Ogami
Sponsor: Laura Starkston, Ph.D.
Mathematics

The fundamental group is a topological invariant that measures loops with fixed base points in a space. Two loops are considered to be equivalent if one can be continuously deformed into the other. Since the fundamental group is preserved under homeomorphisms, computation of this group can provide us with important information about many interesting spaces. In particular, we consider the complement of braided surfaces. It was shown that the fundamental group of the complement of a complex curve can be calculated using braid monodromy. We examine how a surface behaves around a singularity. To each complex curve, we associate a braided surface that gives us a topological description of the curve. We focus on a subset of braided surfaces with only transverse multi-intersection singularities. These can be studied using braided wiring diagrams. The wires encode information about the position and arrangement of the intersection points of the curves, whereas the braids illustrate how the curves behave before they intersect.

Heightened Respiratory Sinus Arrhythmia as a Function of Freezing Behavior in Preschool-Aged Children

Sumire Okada
Sponsor: Paul Hastings, Ph.D.
Psychology

Dysregulated fear (DF) involves demonstrating high fearfulness in low-threat situations, and is a risk for social anxiety (Buss et al., 2018). During fear, adaptive cardiac control involves parasympathetic decreases, as indexed by lower respiratory sinus arrhythmia (RSA; a parasympathetic measure). Paradoxically, studies find children with DF respond to threat with increased RSA, perhaps because they freeze in fear (Buss et al., 2018). Fear responses can include "fight-or-flight" or "freezing." Whereas the fight-or-flight response indicates heightened sympathetic activity, freezing reflects increased parasympathetic activity in animal models (Roelofs, 2016), suggesting that heightened RSA in DF children may result from freezing (Buss et al., 2018). This study investigates differences in RSA reactivity as a function of freezing behavior. We hypothesize that children who freeze will display higher RSA than children who do not freeze. Preschool-aged children (N = 182, M_{age}=4.91, SD_{age}=.99) participated in an examiner accident simulation task (EAS), a task wherein the examiner feigns an injury in front of the child to observe children's behavioral and parasympathetic responses. We coded children's fear and freezing behaviors from videos (?=.91) which will be used to test for associations with RSA. The results will help extend knowledge in understanding biological underpinnings for social anxiety.

"From the Portable to the Ivory Tower": Examining the Experiences of U.S.-born Latinx Former English Learners in the UC System

Alfredo Olguin
Sponsor: Margarita Jimenez-Silva, Ed.D.
Education

There are 1.3 million English Language Learners (ELL) in California's K-12 public schools. Of those ELL students, 83% speak Spanish. Further, 54% of all public school students are Latinx (all data, California Department of Education, 2018). Little attention has been given to students who were reclassified from ELL status and have now entered higher education institutions. Few statistics are available regarding this population of students. This study interview data to examine the experiences of ten U.S. born Latinx university students who were previously classified as ELLs in their K-12 schooling and currently enrolled at a University of California campus. Qualitative data was analyzed using constant comparison and analytic induction methods to identify and extract common themes across participants (LeCompte & Preissle, 1993). Several techniques were used to support the trustworthiness of the data, including data triangulation, peer review, member checking, and a search for negative cases. Results include lack of confidence in academic reading and writing as well as reluctance to access academic university services. Recommendations include providing targeted assistance for former ELLs that differentiate between their language needs and those of international students and communities for social and academic support for this population of students.

Factors That Affect Major Choices and Retention Rates of Underrepresented Groups in the College of Agricultural and Environmental Sciences (CA&ES)

Unoma Ononye
Sponsor: Susan Ebeler, Ph.D.
Viticulture & Enology

At the University of California Davis, students are able to select from a vast number of majors. The majors in the College of Agricultural and Environmental Sciences (CA&ES) alone range from community development to animal science and many others. How do students then decide on what to study in such a unique and diverse college? Are these decisions based on family history, prior research on the major or, academic advising and other resources in the major? The goal of our research is to better understand some of the reasons behind choosing a major/s and continuing in that major. Through workshops and student-led discussions we evaluated the relationship between factors such as a sense of community, career connections, resources in the major, circular components and students selection of a major in the College of Agricultural and Environmental Sciences (CA&ES). The information evaluated from the workshops will be used to better inform a diverse array of students about the opportunities associated with the majors in the college. Also, college faculty and staff will be able to use the information to better support prospective students in their major selection process and to enhance retention of students in their selected majors.

Development of Low-Cost Photodiode Sun Sensors for CubeSat Attitude Determination

Aung Htut Oo
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

Sun sensors are commonly used to orient spacecraft by determining the relative position of the sun. Commercial sun sensors typically cost several thousand dollars, rendering them an implausible option for undergraduate research applications. This presentation discusses the development of sun sensors that use photodiodes as an inexpensive alternative. Preliminary results strongly indicate the viability of using photodiodes as sun sensors for attitude determination in space. A testbed is developed to facilitate testing of the photodiodes in various configurations and characterize their performance and accuracy. The development of low-cost photodiode sun sensors is documented in more detail than existing literature, describing the implementation of mathematical equations into code, circuitry construction, mechanical and experimental design, and fabrication. The resulting sun sensors design will be used for attitude determination on the REALOP CubeSat, the first satellite created by undergraduate students at UC Davis. Additionally, this documentation will be an invaluable resource for undergraduate students across the world who also choose to take a low-cost approach to attitude determination for their own CubeSats.

Production of Glucosinolate-derived Defense Compounds in *Nicotiana benthamiana*

Izaiah Ornelas
Sponsor: Patrick Shih, Ph.D.
Plant Biology

65% of all US crops are lost to pests before the application of pesticides. To combat this, 3 billion kilograms of pesticides are annually applied leading to unintended detrimental effects on the surrounding environment. Glucosinolates are secondary metabolites produced by plants in the Brassicales order. Upon tissue damage, glucosinolates are hydrolyzed by thioglucoside glucohydrolases (myrosinases) to form a variety of compounds that include isothiocyanates, which shows toxicity, growth inhibition, and feeding deterrence to a variety of potential plant enemies. Using transient expression, Nicotiana benthamiana (tobacco) was engineered to produce indole glucosinolates and its downstream hydrolysis products with the introduction of various myrosinases. Metabolites were extracted from tissue samples to determine which compounds were produced using mass spectrometry. Samples that underwent simulated mastication were also screened to examine the production of toxic or off-target compounds. This analysis will be used as proof of concept for future studies that examine glucosinolates biopesticide production in other relevant crops.

Synthesis of Nanoplasmonic Materials for Wide Application in Liquid Biopsy

Hannah O'Toole
Sponsor: Randy Carney, Ph.D.
Biomedical Engineering

There has been considerable interest in the use of circulating extracellular vesicles (EVs) for next-generation liquid biopsy platforms. In malignant tumor cells, EVs display altered composition, including various surface markers that could act as diagnostic handles. However, the sensitivity of detection of these surface markers remains a challenge, particularly for early-stage cancer. Taking advantage of the optical tunability property of gold nanoparticles (AuNPs), we are working on a nanoplasmonic-based detection system for sensing tumor EVs. The optimal properties of these probes are (1) small size suitable for multiplexing many probes to an EV's surface and (2) plasmon resonance in the near-infrared (NIR) to maximize biocompatibility. These two features have not yet been simultaneously attained and remain a grand challenge for nanomaterials synthesis. Thus, I aim to 1) develop and implement a reproducible synthetic strategy for sub-100 nm gold nanomatryoshkas (novel core-shell-shell nanomaterials), and 2) evaluate the optical properties of these particles for future use in diagnostic platforms. The current focus of the project is optimizing the growth of thin gold shells around a small silica core to achieve these two aims via a primary and alternative set of synthetic strategies.

Mathematical Modeling, Automated Manufacturing, and Verification Testing of Low Cost Magnetorquers for 3 Axis Control for UC Davis CubeSat Mission

Trevor Ottoson
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS magnetorquer coil development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. In hopes to launch a platform for future Earth science based missions and offer guidance for other low-cost university nanosatellites, this presentation will discuss the optimization and manufacturing process for a single unit configuration of 1 air core and 2 torquer rods. Through extensive mathematical modeling coupled with physical testing for verification, a customized configuration can be designed and manufactured in-house. The selection of magnetorquer dimensions and materials were determined through research and analysis to meet system detumbling and desaturation requirements. To efficiently manufacture the prototype, a coil winder was designed, assembled, and programmed. This adaptive and modular coil winder is designed for reliability and repeatable prototyping. The information to create highly-customizable magnetorquer structure with a coil winding device can be utilized as tools by other universities and research institutions with little to no experience in CubeSat development by significantly lowering the barrier of entry and expanding mission scope.

Nuclear Science and Other Hot Stuff: Using Concept Maps to Assess Student Growth

Shawlene Pal
Sponsor: Julia Chamberlain, Ph.D.
Chemistry

Concept maps present a graphical organization that visually illustrates the authors' connections between different concepts and how they are related. Concept maps are a widely employed teaching and assessment tool that can be interpreted using an array of evaluation methods. Moreover, the flexibility of concept maps allows students from diverse backgrounds to share ideas about a topic without confining formatting structures or boundaries. In a 1-unit elective seminar about nuclear science, twelve undergraduate students were assigned concept maps as an in-class activity to communicate their knowledge of nuclear science on the first and last days of class. We examined student concept maps to identify major themes in students' ideas and to examine changes in students' perspectives on nuclear science. By identifying and interpreting indicators, such as the number of concepts or branches on each map, changes in student understanding over the course of the quarter can be quantified. We will share the results of analyzing nuclear science concept maps from our seminar, and will provide insight on the utility of concept maps to measure changes in learning and attitudes. This knowledge may be used during the development of future seminars to enhance the content, delivery, and student experience.

Relationship Between Language Development and Social Interactions in Dual Language Learner Preschoolers

Sharon Pala
Sponsor: Joseph Anistranski, Ph.D.
Human Ecology

Growing children reflect development through their verbal communication and social interactions with others. The purpose of this study is to explore the correlation between the social and language development domains in children who are dual-language learners. Peer and adult interactions and verbal communication during free play time of four preschool children at the UC Davis Early Childhood Lab School were observed over the course of nine weeks. These children began with limited to no English at the beginning of the academic school year (October 2019), but were provided intentional exposure to words and simple phrases by teachers in child-initiated play and teacher-initiated learning experiences. A positive correlation was found between English language development and the number of peer and adult interactions that the child engaged in during child-initiated play. The findings suggest that the best way for language development to occur in children would be to encourage and place them in environments where trusted adults are present, labeling and describing play, and facilitating peer to peer interactions.

In-Plane Molecular Transport in Nanoporous Gold Thin Films

Barath Palanisamy
Sponsor: Erkin Seker, Ph.D.
Elect & Comp Engr

For effective pharmaceutical prevention of sporadic seizures, administered drugs need to cross the blood-brain barrier (BBB) and target specific brain regions – a major therapeutic obstacle. We investigate nanoporous metals as potential implantable drug delivery platforms to circumvent the need for BBB transport. The proposed platform needs to allow for controlled and sustained release of drug molecules. For the latter, we aim to achieve the replenishment of small-molecule drugs from a distal reservoir to the site of interest via in-plane transport through micropatterned nanoporous gold (np-Au) thin films. Np-Au thin films can be readily integrated into devices via standard microfabrication processes and allow for high-fidelity electrophysiological recordings. Here, we demonstrate that the np-Au thin film traces allow for the transport of fluorescein (a small-molecule drug surrogate). Specifically, we study the transport rate of fluorescein reconstituted in deionized (DI) water and physiologically relevant phosphate-buffered saline (PBS) solution for different np-Au film thicknesses and pore morphologies. Transport in DI is negligible due to strong non-specific interaction of fluorescein with the pore walls, where chloride in PBS reduces this interaction. Thicker films increase the transport rate due to the additional cross-sectional area. Different pore morphologies exhibit a negligible influence on the transport rate.

Retention of Green Leaves Not Brown Leaves Increases Spring Cynipid Diversity On Valley Oaks

Vincent Pan
Sponsor: Richard Karban, Ph.D.
Entomology/Nematology

Past work suggests that overwinter leaf retention incurs a cost of higher herbivory load in the following growing season; however, whether this phenomenon depends on the physiological activity of the overwintering leaves remains unknown. We surveyed the overwinter retention of physiologically active green and inactive brown leaves of valley oaks (Quercus lobata) and examined their relationship with the diversity and density of 15 gall-making cynipid wasp species. Cynipid diversity and densities in the spring were greater on larger trees with more green leaf retention. Brown leaf retention was not associated with cynipid diversity but was related to substantial reductions in cynipid densities on large trees. Retention of both leaf types was generally a poor predictor of summer cynipid diversity and density; rather, tree size appears to be the most important factor for this time period. Overall, green leaf retention better explained cynipid diversity, but brown leaf retention generally better explained cynipid densities. Green and brown leaves both provide unique predictions and probably impact herbivores through their unique mechanisms; green leaves may provide a common cue used by herbivores to find a suitable host and brown leaves may arrest immobile herbivores at unfavorable overwintering sites.

Investigating the Role of Brazzinazole Ressistant1 in *Solanum lycoperscium*

Kelly Pan
Sponsor: Siobhan Brady, Ph.D.
Plant Biology

Plant hormones are signalling molecules that play important roles in development and stress responses. One class of such hormones are brassinosteroids, which specifically regulate how plants react to phosphate starvation. Brassinazole Resistant1 (BZR1), a transcription factor, is responsible for regulating downstream brassinosteroid signaling in Arabidopsis, ultimately triggering changes in root architecture. BZR1 upregulates transcription when phosphorylated by precursors in the pathway, but otherwise accumulates in the cytoplasm. Mutations in a specific domain of BZR1 result in constitutively active forms of BZR1, and Arabidopsis lines carrying these mutations do not display the same changes in root architecture in response to phosphate starvation. While BZR1 is well studied in Arabidopsis, it is unknown whether it's mechanism is conserved across species. We identified homologs of BZR1 in tomato (Solanum lycoperscium), and designed constructs expressing constitutively active mutant forms of these genes. Such constructs were then stably introduced into two tomato strains. Our current efforts focus on measuring the change in root architecture in these lines. Understanding the phosphate response in crop species will allow us to innovate in agriculture, giving us the knowledge to create more efficient fertilizers and heartier crops.

Museum Design to Preserve Local Culture: Gurase Bhume Aama Samuha Sangrahalaya

Regina Paredes Martinez
Sponsor: Nancy Erbstein, Ph.D.
Education

In our presentation, we will discuss our research conducted in the village of Maccahpuchhre, Nepal with the Ghurase Bhume Aama Samuha. We were tasked with creating a mural for a local museum to depict the local Gurung culture of the village and enhance the aesthetics of the museum through the general organization of the space. The village's mothers' group, Gurase Bhume Aama Samuha, has a donation-funded building set aside for the museum. The museum is a tool for the Mother's group to preserve their local traditions as educational and rural modernization creates a disconnect from youth in the village to their local traditions. We planned to achieve our objectives by conducting interviews with museum professionals, researching social and cultural contexts of Nepal that will influence the museum, conducting interviews of members of the Machhapuchhre Village, and working with and for the Aama Samuha. We shared our work with the community by collaborating throughout the ten day process. We asked the Aamas to share their traditions and stories through their artifacts which we then depicted in the three murals and the accompanying shelves.

Engineered Silver Silica Nanomaterials in Injured Lungs

Sidney Parel
Sponsor: Laura Van Winkle, Ph.D.
Cntr For Health & Environment

Prior research using healthy animal models has confirmed engineered silver silica (AgSi) nanomaterials cause toxicity in the lungs, yet few studies investigate the impact of its inhalation in models with lungs compromised by air pollution. To understand interactions of AgSi nanomaterials with lungs in a continuous state of injury and repair, an experiment was developed to assess the interplay of ozone, a known oxidant and pervasive air pollutant, and AgSi particle deposition in a rat model system. We examined macrophage activation and particle location and abundance in cells in bronchoalveolar lavage fluid (BALF) from 42 male Sprague-Dawley rats across four exposure groups (AgSi, ozone, filtered air, and AgSi with ozone) at two timepoints (two- and 24-hours post-exposure). Uptake of particles was scored histologically, and the volume of cells occupied by particles was measured using particle specific masking. Additionally, site-specific gene expression for macrophage inflammatory protein-2 (MIP-2) was measured in microdissected lungs. Initial findings include upregulation of MIP-2 in AgSi exposure groups; therefore, we anticipate greater macrophage activation and particle phagocytosis in AgSi exposure groups. These studies address limitations in current nanotoxicology models and provide information useful to people at risk of occupational exposure to engineered nanomaterials and air pollution.

Title: Shoes that Last: a Sustainable Approach to Growing

Andrew Park
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Title: Shoes that Last: A Sustainable Approach to Growing

Children's bodies grow rapidly during their first few years, which results in high consumption of children's clothing. In particular, children's shoes might only be used a few times before needing to be replaced. It is estimated that children, in general, grow out of their shoe sizes at least 3-4 times a year. This rapid shoe consumption contributes to waste and can also be a financial burden for families with young children. Based on the results from user interviews and secondary research on existing products, we propose to design a children's shoe that can accommodate foot growth across multiple shoe sizes. To do this, we will incorporate a number of recent innovations in functional apparel, such as expandable knits, experimental closures, waterproof finishes, and flexible soles to arrive at a prototype that is comfortable, functional, and long-lasting. With this project, our design can lead to more sustainable products that incorporate innovative materials and construction techniques for transformable wearable design applications.

Effects of Abortion Clinic Closures in Texas on the Female Labor Supply and Schooling Outcomes

Alyssa Parr
Sponsor: Giovanni Peri, Ph.D.
Economics

House Bill 15 was passed in Texas in 2011 to make it inconvenient for women to receive an abortion. House Bill 2 introduced "TRAP laws" to Texas in 2013 to make it difficult for abortion clinics to remain open in future years. Starting in 2013, many abortion clinics did ultimately close in Texas, decreasing the access that a woman has to receive an abortion. Using data on abortion clinic closures, I estimate the effect of losing access to a clinic on women in the labor force, the number of weeks worked in the previous year, and on the probability a woman completes high school or higher. I will also consider the effects of abortion clinic closures on the number of women getting married. Together, there is evidence to suggest the probability of being in the labor force, completing high school or higher, and the number of weeks worked decreases for younger women. We notice an increase in the number of women getting married across most groups of women, including both age categories.

Environmental and Performance Testing of Hard Disk Drives as Low-Cost CubeSat Reaction Wheels

Pedy Louie Pascual
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Hard Disk Drive (HDD) tech demonstration of the ADCS for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Commercial CubeSat reaction wheels cost on the order of 10^4 to 10^5 USD. REALOP will repurpose 30 USD hard disk drives, typically found in laptops and iPods, as a low-cost alternative to commercial reaction wheels. Mass-manufacturing of HDDs to high precision standards make them a very reliable and accessible technology. A highly configurable, low cost ESC IC was adapted to control and report the speed of HDD motor for precision attitude control. Appropriate mass and speed properties indicate that HDDs can meet the control requirements of the 2U REALOP CubeSat. Environmental testing is performed on multiple popular and readily-available models of HDDs to verify which can, or cannot, withstand launch and orbit conditions. Performance testing is conducted on an air-bearing testbed to characterize the HDDs and demonstrate that they meet mission pointing and stabilization requirements. Successful integration and on-orbit testing can further prove the utility of HDDs as reaction wheels for low-budget small satellite missions.

Supplementation of Poultry Feed with California Byproducts

Aiko Pasion
Sponsor: Annie King, Ph.D.
Animal Science

California (CA) is the top producer of broccoli, tomatoes, grapes, various nuts, and many other agricultural commodities within the United States. However, 4.7 million adults and 2.0 million children across CA are affected by food insecurity. One way to address the problem of food insecurity in CA is the redirection of usable byproducts that often become food waste (6 million tons), representing 18% of materials that are stored in landfills, causing issues for the environment. Byproducts (food processing waste), grocery store waste, and even household waste can be used to supplement the feed of livestock, especially chickens. Demand for poultry products in US has grown by 5% from 2018 to 2019, and is expected to continue. Chickens fed diets containing various byproducts have final weight, feed consumption, and feed conversion ratios similar to that of birds fed commercial corn/soy diets. The goals of this study were (1) to review the horticultural products grown in CA, (2) identify their byproducts, and (3) discuss their use in poultry feed.
Some CA byproducts reviewed include tomato pomace, grape seed extract, broccoli stems and leaves meal, cow peas, sunflower seed meal, olive pomace, and nonpathogenic grocery waste (vegetables, fruits, bakery food, meat and fish).

Effect of Beta-estradiol on Endothelial Cell Function

Lorena Pastor
Sponsor: Sumathi Sankaran-Walters, Ph.D.
MED: Medical Microbiology & Imm

Estradiol is the most potent estrogen that naturally circulates within the body. Estradiol is produced mainly in the ovaries and placenta and it protects the renal and cardiovascular systems. As women begin to enter menopause, estrogen synthesis decreases due to lower functioning ovaries. The decrease in estrogen is why women experience postmenopausal symptoms; this decline may also be a factor in heart disease increase among postmenopausal women. The Women's Health Initiative (WHI) extensively studied the cardiovascular risk in women receiving post hormonal estradiol therapy. The question of whether estradiol had direct effects on endothelial cells was thus unknown. We hypothesize that physiological levels of estradiol protect endothelial cells. We utilized arterial and venous endothelial cell lines in culture to investigate the effects of estradiol on cell proliferation, inflammatory changes and endothelial junction formation. Physiological levels of estradiol are associated with decreased levels of inflammatory changes in endothelial cells while higher levels are pro inflammatory. These results will contribute to the body of knowledge following the results of the WHI study. In this study, higher levels of exogenous estradiol increased cardiovascular risk in older women. Further studies are needed to elucidate the mechanism of action of estradiol on endothelial cell function.

Visual Representation of UC Davis' Nitrogen Footprint

Shona Paterson
Sponsor: Benjamin Houlton, Ph.D.
Land Air & Water Resources

Nitrogen is an important nutrient found and used throughout human and natural ecosystems. Worldwide, advanced nitrogen fertilizer technologies are estimated to support food production for over 3 billion people while developed economies have seen gains in nitrogen use efficiency by crops. However, excess amounts of reactive nitrogen can lead to declines in global health, biodiversity, and air and drinking quality when it is lost from soil. A nitrogen footprint provides a standardized measure for the amount of reactive nitrogen released by an entity, such as a university. Using ArcGIS Pro, which is a mapping application that allows us to represent numerical data spatially, we created an interactive map of the embodied and local emissions of UC Davis based on the 2018 nitrogen footprint that the UC Davis Office of Sustainability calculated. We focused on emissions from major contributing sectors such as food, utilities, transportation, research, and wastewater, as well as fertilizer and refrigerants. By visualizing the nitrogen emissions data, we hope to help individuals understand the source of nitrogen emissions on campus and assist people in making more sustainable lifestyle choices. Additionally, we hope to help campus decision makers understand the impact of operations and highlight opportunities for reductions.

Development of Flight Software and Analysis Tools for CubeSat Attitude Determination and Control System

Ayush Patnaik
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS software development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. Flight software is developed to determine and control the attitude or orientation of the CubeSat by integrating sensor data and giving commands to the hardware. The attitude determination algorithm, TRIAD, is developed to integrate sensor data with mathematical models to output the state of the satellite. The output is used by B-Dot and PD, which are closed-loop algorithms allowing the hardware to stabilize the satellite and point the cameras towards Earth. Integrated software and hardware testing is performed to verify that the system meets requirements. A virtual model of the CubeSat, VirtualSat, is also in development to simulate the in-orbit motion of the satellite, while taking external factors like drag, solar radiation, etc. into account. VirtualSat will be an open-source tool that will allow other missions to visualize spacecraft dynamics and develop control algorithms.

Phenotypic Traits of Plantago lanceolata as Related to Density and Demography

Sophia Pelletier
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

This project is a continuation of a study on the globally-distributed perennial plant Plantago lanceolata that has been conducted annually since 2016. This study uses the protocol of Plant Pop Net, an international project, which aims to understand the factors driving the spatial dynamics of plant populations in response to climate change using data from P. lanceolata populations around the world. At our site in Davis, CA, we measured the abundance and phenotypic traits of P. lanceolata for four years. The trait data includes floral characteristics, phenology, morphology, and signs of herbivory. Using this data, we want to investigate leaf area as a measurement of plant size as well as compared to rosette density. We would like to explore what affects plant size and density have on survival and reproduction. In previous years, we have found relationships between plant size and density to be significant. We would like to further examine these relationships through comparison with past data from our site.

The Uncertainty of DACA

Jasmin Pena
Sponsor: Erin Hamilton, Ph.D.
Sociology

Access to higher education has become more uncertain for undocumented youth. In 2012, the Obama administration passed DACA and among the requirements to be eligible, one had to be 15-30 years of age in 2012 and have completed high school. This means that todays current college attendees are the prime college-going age and education group of undocumented students who were eligible for DACA at the time. Two years ago, the Trump administration announced an end to DACA, leaving hundreds of thousands of young undocumented students and their families living under constant uncertainty. The objective of this study is to investigate the effects that the threat on DACA has on DACAmented college students who are part of the Chicanx/Latinx community. We want to see how this uncertainty is affecting students emotionally, socially and academically. Studying the experience of DACAmented students gives us an insight on what happens when people experience changes to their legal status. Data for this study includes interviews with ten Chicanx/Latinx DACAmented college students over the age of eighteen. Results are pending but we predict that despite the uncertainty of DACA, DACAmented college students will remain resilient and continue working towards their future.

Iterative Design and Analysis of Standardized CubeSat Structure

Matthew Pena
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

REALOP is the first UC Davis undergraduate-based CubeSat team with a launch scheduled for Spring 2021. The structures team is responsible for the design and analysis of the CubeSat frame as well as the integration of control hardware and payload. The goal is to create a structural frame independent of payload, that also provides simple integration of and accessibility to the payload, which uses standardized hardware mounting brackets for ease of mission repeatability. The mounting brackets hold different payload components and control actuators. In order to integrate the electrical PCBs and flight computers safely, a slotted housing unit, referred to as the Stackhouse, will be used to electrically isolate the PCBs from the aluminum frame. To simulate the environment that the CubeSat will experience throughout its lifecycle, research regarding the structure's ability to survive the launch environment and maintain the functional integrity of the CubeSat components will be conducted through analysis of mechanical, thermal, and vibrational loads. A standardized, independent CubeSat structure will allow for simple integration of hardware and scientific payloads for future CubeSat missions.

Anabolic Resistance is a Function of Age and not Loading History

Sawyer Peralta
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Muscles become smaller and weaker with age leading to decreased quality of life and chance of falls. These changes in muscle are thought to result from anabolic resistance: impaired muscle protein synthesis (MPS) in response to feeding and exercise. My goal was to determine whether a shorter anabolic response to exercise exists in the highly active soleus muscle. My hypothesis was that MPS following resistance exercise will return to basal levels earlier in older soleus muscles. Adult (10 months) and old (30 months) rats underwent resistance exercise and then were allowed to recover (6H, 18H, and 48H). To measure MPS, puromycin was injected thirty minutes prior to collection and the incorporation of puromycin into protein was measured using western blots. At 6H and 18H, there was no significant change in MPS compared to basal levels in the soleus muscles of either the adult or old rats. At 48 hours, the adult rats demonstrated elevated MPS, whereas MPS decreased below baseline in old animals. These data from the soleus muscle suggest that anabolic resistance is seen in old animals regardless of the loading history of the muscle.

Improving Strength and Material Efficiency of Bio-Based Thermoplastics Using 3D-Printing Methods

Van Willem Peralta
Sponsor: Sarah Miller, Ph.D.
Civil & Environmental Engr

Improving the sustainability of materials is key to reducing climate change and pressure on natural resources. The most common building material used in the built environment is concrete - the production of which is responsible for 8% of global CO_2 emissions. Construction and development must continue to support a growing population, therefore the solution to sustainability involves two solutions: improving material efficiency or switching to alternative materials. This study addresses both by observing the mechanical behavior of polylactic acid, a bio-based thermoplastic. The objective of this study is to determine the mechanical properties of polylactic acid under different 3D-printed infill densities. A “chevron” printing pattern (similar to a leaf structure) was chosen to improve material strength-to-weight ratio and predict failure behavior. Specimens of 25%, 50%, 75%, and 100% printing infill densities were compared to injection molded specimens as the control. Tensile and flexure tests were conducted according to the American Society for Testing and Materials ASTM D638 & D790, respectively. Tests showed the greatest material efficiency at 25% infill density, with an average modulus of 1.7 GPa per gram of plastic. These results give impetus for future studies exploring different infill patterns and ways to improve material efficiency and sustainability.

Single Axis Rotation Testing to Determine Camera Performance Thresholds for UC Davis’ CubeSat Mission

Andre Pereira Bojikian
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

A critical component to the success of UC Davis’ REALOP CubeSat mission is the ability to remotely take clear images of the Earth while in orbit. The goal of this study is to design a controlled testing setup which emulates an orbiting CubeSat to help establish a rotational threshold for which pictures taken by the CubeSat’s onboard camera are of acceptable quality for the mission’s requirements. An air bearing table is used to produce a low friction, freely rotating surface for testing the Raspberry Pi V2 Camera Module. Experimental parameters for the camera include the picture resolution and the lighting environment. Successful demonstration of the air bearing table for free rotation testing not only determines the requirements for the CubeSat’s ADCS (Attitude Determination and Control System), but also serves as a basis to quantify the performance of other components such as reaction wheels and sun sensors to satisfy the mission’s requirements. Characterization of the camera will also support its use in missions outside REALOP and in other low budget university satellite missions.

FcγRIIb Signaling by Germinal Center B Cells Following *Borrelia burgdorferi* Infection

Brayden Perez
Sponsor: Nicole Baumgarth, D.V.M.,Ph.D.
VM: Pathology, Micro, & Immun

Tick-borne infection with Borrelia burgdorferi (Bb) causes Lyme disease in humans and persistent infection of mice, its natural reservoir host. IgG responses critically control Bb tissue burden but do not clear the infection. We previously showed induction of germinal centers (GC) in mice after Bb infection followed by their rapid collapse within 30 days, despite ongoing infection. Our recent experiments revealed that serum IgG from Borrelia-infected mice bound more strongly to the inhibitory FcγRIIb on B cells, as well as recombinant FcγRIIb than those from uninfected mice. The data prompted us to investigate whether the interaction between Bb infection-induced IgG and FcγRIIb results in the suppression of GC. Indeed, Bb-infected mice lacking FcγRIIb signaling (FcγRIIb-/-) maintained GC B cells and CD4 T_{FH} cells for at least 90 days after infection, and GC B cells showed reduced apoptosis. However, despite GC maintenance and the resulting increases in Bb-specific, T cell-dependent IgG responses, enhanced antibody affinity maturation was not observed and Bb tissue burdens of FcγRIIb-/- and control mice were comparable. The data shows the importance of FcγRIIb in the regulation of GC during Bb infection. Further mechanisms under investigation seem to underlie their functional deficits, enabling the establishment of Bb persistence.

Cardiovascular Risk Factors as an Indicator of Age-Related Cognitive Impairment

Emely Perez Pinera
Sponsor: Rachel Whitmer, Ph.D.
MED: Public Health Sciences

Current literature supports that midlife cardiovascular (CVD) risk factors (e.g. obesity, hypertension, high cholesterol, and diabetes) are negatively associated with late-life cognition. Less is known about the relationship between CVD risks developed prior to late-life. Using the Kaiser Healthy Aging and Diverse Life Experiences cohort (KHANDLE; n=1712), we aimed to assess the association between early- and mid-life CVD risks within three age groups (ages 15-28: n= 604; ages 29-34: n=567; ages 35-63: n=541) and cognition assessed in late-life (mean age: 76; range: 65-90). Linear regression analysis showed that individuals with two or more CVD risk factors had lower mean global cognitive test scores (ß=-0.17; 95% CI: -0.28, -0.07) than individuals with no risk factors. Additionally, individuals with high cholesterol (ß=-0.12; 95% CI: -0.23, -0.01) and those who were overweight or obese (ß=-0.11; 95% CI: -0.20, -0.03) had worse global cognitive test scores. Associations were consistent across age groups. These results add to the growing literature highlighting that CVD risk factors in early- and mid-life negatively affect late-life cognition.

Developing a Reference Sequence Library for Mexican Free-Tailed Bat Prey

Serra Perry
Sponsor: Andrea Schreier, Ph.D.
Animal Science

An estimated 250,000 Mexican free-tailed bats (Tadarida brasiliensis) reside in the Yolo Bypass which supports rice agriculture, one of the most important crops in the world. Mexican free-tailed bats provide ecosystem services to local farmers by consuming agricultural pests. Working with Ecology graduate student Ann Holmes, we collected ~300 guano samples in summer 2019 to determine diets of Mexican free-tailed bats. Previous studies determined diets through dissection and morphological identification, but identifying digested prey is difficult. With genetic techniques we can refine prey identities, but we need prey reference sequences to compare with DNA sequences extracted from guano. Reference sequence libraries provide a collection of genetic barcodes that allow the matching of DNA to species. This project will develop a reference library of regional agricultural pests. Insect sequences will be found through searches of genetic databases such as GenBank and Barcode of Life. Insects not genetically databased will be Sanger sequenced and accessible to other researchers. If time permits, we will expand our study using quantitative PCR (qPCR) genetic assays to see if these organisms are present in extracted DNA from bat guano. This research will help identify the contribution of Mexican free-tailed bats to local and sustainable agriculture.

Measuring Motivation for Forage of Feedlot Cattle fed High-Concentrate Diets Using a Short-Term Thwarting Test

Allisen Peterson
Sponsor: Cassandra Tucker, Ph.D.
Animal Science

Finishing Cattle are not adapted to the high-concentrate diet fed on feedlots. Diets higher in fiber show increased saliva production, which act as a ruminal buffer, by stimulating chewing and rumination. High-concentrate rations may cause a potentially damaging drop in ruminal pH further exasperated by low salivation due to decreased chewing. This study aimed to quantify finishing cattle motivation to access forage using a short-term thwarting test. Compared to an added offering of their primary diet, we expected finishing cattle to show more interest in a source of forage. Cattle were group housed and fed a primary diet (16% forage) ad libitum. At 0900 h and 1300 h, sixteen finishing cattle were given either 100 g of primary diet (n=9) or beardless wheat hay (n=7). At 0900 h on Day 5, individuals were given 200 g of treatment feed but were thwarted tactile access, still allowing olfactory and visual interactions. All trials were recorded and behaviors were scored. Using R Sudio, behavioral responses on Days 1-4 were analyzed using repeated measures design with treatment and exposure period as fixed effects, and animal as a random effect. Behavioral responses during the thwarting test were analyzed using a T-Test for differences in treatment means.

Elucidating Metal Binding Interactions with a Peptide Hormone, C-peptide

Quang Pham
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

The connecting peptide (C-peptide) is a hormone that is co-released in equal amounts with insulin in response to an elevation in blood sugar. Although initially thought to be biologically inert, recent studies have revealed that C-peptide plays a beneficial role in ameliorating vasculopathies and kidney dysfunction. Interestingly, studies by our lab and others have observed that C-peptide function may depend on bioavailable metals, particularly Cu(II) and Zn(II). However, little is known about the chemical nature of the interactions, hindering advances in its therapeutic applications. To this end, we are elucidating the relationship between C-peptide and these metal ions through various spectroscopic techniques. We have found that Cu(II) and Zn(II) bind to C-peptide at specific residues, particularly glutamate and aspartate, and that Cu(II) is able to displace Zn(II) for C-peptide binding. These results suggest potential roles in metal-mediated regulation of peptides and hormones, and point to future roles in drug development.

A Novel Three-dimensional Mechanical Actuator for Artificial Hearts

Dina Pham
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Cardiac disease is one of the leading causes of death in the United States. One of the treatments for cardiac diseases is implantation of a total artificial heart (TAH). However, current TAHs have completely different pumping mechanisms from that of the human heart. One reason can be attributed to lack of appropriate actuators. In this research, we developed a mechanical cardiac tissue where the electrophysiology of each individual cell can be simulated and is not dependent on biological materials. A physiologically detailed mathematical model of the left ventricle of the heart was used to model the action potential propagation of a two-dimensional mechanical cardiac tissue. Each cardiac cell in the tissue was simulated in real-time and translated to mechanical motion by an actuator, which was built using a motor and 3D printed structures. A six by six-celled cardiac tissue was created and controlled with a Raspberry Pi microcontroller. Future iterations of this project include the use of smaller actuators, more biocompatible materials, as well as developing a larger cardiac tissue.

Finite Element Modelling of Heat Conductivity for 2D Voronoi-Based Cellular Structures

Dominic Phillips
Sponsor: Barbara Linke, Ph.D.
Mechanical & Aerospace Engr

Cellular solids like foams and lattice structures are attractive materials for use in lightweight design applications in the aerospace and automotive industries. They also feature tailorable thermal properties. Complex cellular solid geometries can be optimized to exhibit a specific thermal behavior in a Computer-Aided Design (CAD) platform before being printed using metal additive manufacturing. In this study, a brief overview of stochastic cellular solids, metal additive manufacturing, and algorithms for generating 2D Voronoi diagrams is given before detailing the development of a computationally inexpensive model in MATLAB for conductive heat transfer in a cellular solid as well as means of easily discretizing said solid. Variations of 2D Voronoi-based topologies and their 3D mechanical equivalents are analyzed with the developed thermal model and are compared qualitatively. The thermal model is vetted by a quantitative comparison of three test geometries using Ansys. Recommendations for model refinement and further work are given.

Optimizing Engineering of Glucoraphanin in *N. benthamiana* Through Co-expression Analysis

Roxanna Pignolet
Sponsor: Patrick Shih, Ph.D.
Plant Biology

It is estimated that 38.4% of adults in the United States will be diagnosed with cancer at some point in their lives (National Cancer Institute). With this high rate of incidence, the exploration of new options for cancer prevention is of great importance. Plant secondary metabolites are good targets for study due to their potential to be used in anti-cancer dietary supplements. Isothiocyanates are products of the glucoraphanin biosynthesis pathway that have been demonstrated to display potent anti-cancer properties. Previous studies have identified the genes in the core glucoraphanin biosynthesis pathway (CGBP); however, heterologous expression of the CGBP in tobacco produced dihomomethionine (a glucoraphanin precursor) at only 432 nmol g^{-1} fresh weight (Crocoll 2016). We used co-expression analysis to identify 49 gene candidates for optimizing the CGBP and tested them for their effect on glucoraphanin biosynthesis using transient expression in tobacco. LC-MS analysis of the transformed leaf tissue revealed that that a significantly higher concentration of glucoraphanin can be obtained by adding both gene 49 and dCGS to the CGBP. This increase in glucoraphanin implicates these genes as important factors in the glucoraphanin biosynthetic pathway with the potential to raise concentrations closer to recommended supplement quantities.

Behavioral and Physiological Effects of Housing Density on Pair Bonding Primates

Brianna Pinto
Sponsor: Karen Bales, Ph.D.
Psychology

Primates live in a variety of social groupings and vary in the expression of species-typical behaviors depending upon social conditions. Coppery titi monkeys (Plecturocebus cupreus) are pair bonding, territorial primates used to study social behavior. In captivity, close proximity between these territorial monkeys may result in density-induced stress responses. We measured behavioral and physiological variables related to pair bonding in 27 pairs of titi monkeys and predicted higher density housing would reduce affiliation within pairs, but increase urinary glucose, compared to lower density housing. Affiliative behavior was recorded via bihourly scan sample. Urinary glucose values were evaluated using urinalysis strips. As predicted, we found that titi monkey pairs were significantly more affiliative in lower compared to higher density housing during their first month ($p=0.0004$) and last month in each location ($p=0.008$). Urinary glucose values differed based on housing density ($p=0.03$) in a direction opposite to our prediction, but this result may be due to confounding factors unrelated to density. The results of this study suggest that titi monkey pair behavior is influenced by the number of conspecifics present, and management decisions should reflect the implications of these stress responses on the results of social studies.

Parent Acculturation and Children's Oral Proficiency: A Study with Head Start DLL Preschoolers

Cecilia Plascencia
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Past research has shown that the levels of immigrant parent acculturation (PA) affect their adolescents' academic success and motivation. Research has focused on adolescents from Mexcian-American families. To expand on this topic with younger children and dual language learners (DLLs) from other backgrounds, we recruited DLLs from low-income immigrant families who were enrolled in Head Start centers in Northern California. A total of 27 DLLs from Mexican-American and 81 DLLs from Chinese-American families were assessed on the Picture Vocabulary, Oral Comprehension, and Understanding Directions subtests on the Woodcock-Johnson Tests. PA was collected with the Parent Cultural Social Acculturation, Parent Family Ethnic Socialization Skill, and Parent Ethnic Identity Scales. Results reveal that there were many similarities between the two groups on PA and DLLs' bilingual proficiency. However, Mexican-American parents had higher heritage language identity and heritage language media usage than Chinese-American parents. Correlation results show that parent's self-perceived English proficiency and parental English media usage were correlated with DLLs' English oral proficiency. These results suggest that the PA levels and the bilingual proficiency of Mexican-American and Chinese-American preschoolers are more similar than different and that there may be an association between PA and DLLs' English proficiency.

Testing for Adaptation Potential in the Plant Pathogen *Botrytis cinerea*

Taylor Plaziak
Sponsor: Daniel Kliebenstein, Ph.D.
Plant Sciences

Botrytis cinerea is a generalist fungi that infects over 200 plant species resulting in annual crop loss of up to $100 billion worldwide. B. cinerea has a wide genetic diversity, which may provide the ability to adapt to its changing environment, proliferate in host populations, and expand to other hosts. However, the source and effects of this genetic diversity are not well understood. While B. cinerea is capable of sexual reproduction under specific conditions in a lab, there is limited evidence of the sexual cycle in the field. The aim of our project is to determine if B. cinerea undergoes adaptation through mitotic recombination under nutritive selective pressure. To assess potential adaptation, the phenotypes of progeny and parental strains were compared after multiple generations on four different synthetic media. Some of the phenotypes compared included growth rate, melanin production, and sclerotia formation. We will analyze genotype characterization of advanced generation strains with PCR and gel electrophoresis.

Diagnostic Reclassification by a High-Sensitivity Cardiac Troponin Assay

Michelle Polen
Sponsor: Bryn Mumma, M.D.
MED: Emergency Medicine

High-sensitivity (hs) cardiac troponin (cTn) assays are being introduced in United States emergency departments (ED) as a diagnostic assay to identify myocardial infarction (MI) and myocardial injury. The potential changes in patient diagnoses of myocardial infarction or injury resulting from these hs-cTn results are not well described in medical literature and research. The objective of this study is to describe the rates of diagnostic reclassification between conventional cTn and hs-cTn, and between universal and sex-specific hs-cTnT thresholds in ED patients. A prospective, observational study was conducted of ED patients under the age of 18 years undergoing cTn testing in the ED. Diagnostic reclassification occurred when a patient received a diagnosis of MI or myocardial injury using one assay but not the other assay. Results of this study showed that compared to conventional cTn assays, high sensitivity assays resulted in no clinically relevant change in acute MI diagnoses but substantially more myocardial injury diagnoses. Further research on the impacts of these changes relating to myocardial injury diagnoses are critical for emergency departments across the United States.

Effect of Hearing Loss on the Auditory Cortex of the Rhesus Macaque Monkey

Diana Polhac
Sponsor: Gregg Recanzone, Ph.D.
Neuro Physio & Behavior

Humans with high frequency hearing loss due to aging often complain of consistent tinnitus; a symptom characterized by ringing in the ears without external sensory stimulation, at the highest frequency that they can hear. It's effect on the patients' life can range from nuisance to severe impairment of daily activities even resulting in depression. Partial cochlear lesions in young animals result in a reorganization of the auditory cortex such that a large area of tissue becomes responsive to the highest frequency that the animal can still hear. It has been speculated that the same type of reorganization seen in experimental animals to acute hearing loss also underlies tinnitus in aged humans. The objective of this study is to investigate potential differences in the activity of individual neurons between the reorganized and non-reorganized areas of the auditory cortex in an aged alert male macaques using standard extracellular recording techniques. Tones stimuli are sinusoidal waves presented at the frequency that the neurons respond best to for durations of 0.1, 1, 10, and 100 seconds. Preliminary results suggest clear differences in the responses of neurons in the reorganized and un-reorganized cortex, consistent with the idea that this could underlie the tinnitus percept.

Genetic Investigation of Juvenile Idiopathic Epilepsy

Rachel Poulo
Sponsor: Carrie Finno, D.V.M.,Ph.D.
VM: Population Hlth & Reprod

Juvenile Idiopathic Epilepsy (JIE) is an autosomal dominantly inherited disease affecting Egyptian Arabian foals. JIE is clinically characterized by repeated seizures that recede in affected foals after one year of age, with definitive diagnosis made via electroencephalogram (EEG). A genome-wide association study across 670,000 single nucleotide polymorphisms (SNPs) was performed in nine JIE-affected and 29 unaffected Arabian foals. A 25 kb region of association was identified on chromosome 1 (chr1). While there were no annotated candidate genes in this region, a novel gene was identified. A BLAST search matched this uncharacterized gene to a region on chr11 of the human genome associated with Benign Rolandic Epilepsy in humans. Therefore, we hypothesize that there is a structural rearrangement occurring on chr1 in JIE affected horses associated with this novel gene. As the equine reference sequence is a Thoroughbred (EquCab 3.0), a de novo assembly using affected and unaffected Egyptian Arabian horses will be performed. Additionally, RT-PCR will be used to amplify this cDNA on chr1 to determine its expression in young horses. These findings would provide a genetic test for JIE in horses and provide insight into the associated genomic region for Benign Rolandic Epilepsy in humans.

Assessment of Various Extracellular Vesicle Isolation Methods Through Chemical Analysis with Surface-Enhanced Raman Spectroscopy

Alyssa Powell
Sponsor: Randy Carney, M.D.,Ph.D.
Biomedical Engineering

Extracellular Vesicles (EVs) are abundant nanoscale biological messengers released by every type of cell and can be isolated from various biofluids. There is ongoing debate about which is the most appropriate method for isolation of EVs, with most labs using some combination of differential ultracentrifugation (UC), size-exclusion chromatography (SEC), and/or density gradient ultracentrifugation (DG). We applied a surface-enhanced Raman spectroscopy (SERS) analysis platform to compare chemical composition of the isolate from each method against lipoprotein standards to assess the relative purity of the EV preps. 2-3 mL of plasma was separated from whole blood collected from head and neck cancer patients. Each sample was split into 3 batches and EVs were isolated by either SEC, UC, or DG procedures. SERS analysis of SEC, UC, and DG isolated EVs were chemically distinguishable using simple principle component analysis. We found that UC isolated populations clustered with the high-density lipoproteins, SEC populations with the low-and very low-density lipoproteins, and DG populations were more variable, but mainly clustered together with the high-density-lipoproteins. This set of experiments matches our expectation that no single isolation method could separate pure EV samples. This study also illustrates the utility of label-free SERS analysis for rapid chemical characterization of EVs.

Characterizing the Transkingdom Fungal Pathogen *Fusarium falciforme* as a new Pathogen of Cowpeas (Vigna unguiculata) and Potential for Management Using Resistant Cultivars

Harrison Powell
Sponsor: Cassandra Swett, Ph.D.
Anr Plant Pathology

Root and crown rot caused by the fungus Fusarium falciforme is a disease that affects tomatoes and preliminary data has shown that cowpeas, Vigna unguiculata, may also be a host for Fusarium falciforme. The goals of this project were to: (1) determine whether Fusarium falciforme is a pathogen of cowpeas, by assessing impacts on growth, symptom development and yields under field conditions, and (2) determine whether cultivar resistance is a possible management option, by evaluating whether cultivars vary in pathogen susceptibility. Transplants were inoculated and grown in the field from June to October 2019. Fusarium falciforme caused plant stunting, which significantly reduced shoot biomass compared to non-inoculated plants (ANOVA, p=0.017), but we were not able to reproduce the foot rot symptoms observed in grower fields. Yield impacts, based on dry pod biomass, were also not observed. Cultivars varied in susceptibility, in which shoot biomass of CB50 was the least affected by F. falciforme, compared to controls, whereas and CB46 and N2 biomass were most affected by the pathogen. This study suggests that F. falciforme may be a pathogen of cowpea and cultivar resistance could be used to manage this disease.

The Role of Oligodendroglial HMGB1 in Demyelinating Disorder

Preeti Prabhu
Sponsor: Fuzheng Guo, Ph.D.
MED: Neurology

Multiple sclerosis (MS) currently affects about 1 million adults and 10,000 children in the U.S. This degenerative disorder is the most common autoimmune-initiated, demyelinating disorder affecting the central nervous system. Affected immune cells release proteins such as High Mobility Group Box 1 (HMGB1): an endogenous danger protein released from damaged cells for stimulating an immune response which likely leads to lesions in tissues. I aim to define the role of oligodendroglial HMGB1 in the pathogenesis and tissue repair in MS. A mouse model of MS, experimental autoimmune encephalomyelitis (EAE), was induced in both wild type and HMGB1 knockout mice. Western Blot and immunohistochemistry were used to test the presence of HMGB1 in spinal cord tissue. Clinical scoring techniques of the mice's movements indicate that wildtype and HMGB1 knockout mice both progressed through the illness at a similar rate; however, the HMGB1 knockout mice displayed improvement after the sudden onset, while the wildtype mice continued to regress. Once we understand the function of HMGB1, targeted solutions toward MS can be initiated.

Analyzing the Effect of Assignment Structures on Students' Problem-solving Performance in Chemistry

Vishwanath Prathikanti
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

The questions in the practice assignments given to students in the form of worksheets or other formats are often grouped by chapter, topic, or concepts. There is a great emphasis on categorization. Most of the end-of-chapter problems in chemistry textbooks are organized by sections. Although this was done with the intention of helping students navigate the assignments more easily and practice in order, it is not what they are expected to do during the tests. There is a mismatch between what they practice on and how they are tested. The goal of this study is to examine the influence of the structure of the assignments on students' problem-solving performances. Two groups of students from chemistry classes will be recruited to participate in this study. Each group will have the same length of practice and identical questions with only one difference. The experimental group will have assignments with mixed questions, while the control group will have traditional assignments with the questions organized around chapters and topics. Students will complete three two-hour long sessions during the weekends. Evaluation of their progress will consist of their written thinking process and one pre-test and three post-tests, with one given after each problem-solving session.

Detecting Ultra High Energy Cosmic Ray Muons with Android Smartphones

Christian Pratt
Sponsor: Michael Mulhearn, Ph.D.
Physics

Ultra high energy cosmic rays (UHECRs) are compelling interstellar phenomena that produce a shower of particles when entering Earth's atmosphere, one of the byproducts being a muon that travels fast enough to reach the surface due to special relativity. Traditionally, expensive particle detectors are used to detect the presence of these high energy muons, but with the Cosmic Rays Found in Smartphones (CRAYFIS) project, the utilization of current sensors in modern smartphones, that possess technological specifications capable of observing cosmic ray muons, provide a cost effective and pervasive method to further contribute to the understanding of UHECRs. I present numerical and graphical analysis of data collected during a study of Android smartphone models, which utilize a new statistical analysis method implemented into the analysis scripts that will aid in the elimination of noise during the phone's detection process. Previously used identification scripts were modified to generalize the observation procedure for multiple smartphone models. Detection results are compared to a particle detector's observations to measure the efficiency of complementary metal oxide semiconductor (CMOS) sensors in smartphones.

Development of Low-Cost and Reliable Reaction Wheel for CubeSat Attitude Control

Zachary Price
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the Manufactured Reaction Wheel (MRW) component of the REALOP mission, UC Davis's first and completely undergraduate-led CubeSat mission. Reaction wheels are required by REALOP to point the satellite's visual and infrared spectrum cameras toward Earth and stabilize them to avoid motion-blur. The REALOP mission is developing low-cost and reliable reaction wheels for CubeSat application. These components are manufactured through the use of the student machine shop on campus, ensuring the cost-effectiveness and documentation of the manufacturing process. To mitigate risk of failure, reaction wheel prototypes will undergo extensive testing to verify that the design withstands launch loads and operates in the vacuum and temperature ranges of low Earth orbit for extended periods of time. Costs of commercial CubeSat reaction wheels typically exceed total budgets for university missions; successful demonstration and detailed documentation of REALOP's reaction wheel will provide university missions with a low-cost and reliable design, lowering barriers to entry to space and improving mission success.

Examining Attentional Disengagement in Autism Using the Gap-Overlap Paradigm

Melanie Prieto
Sponsor: Susan Rivera, Ph.D.
Psychology

In prior research using the gap-overlap paradigm, Autism Spectrum Development (ASD) has been associated with slow disengagement of visual attention relative to Typical Development (TD). This attentional pattern has often been described as "sticky" or "obligatory" attention, or more rarely as "monotropic" hyper-focus. In the gap-overlap paradigm's gap condition, participants can fixate on a peripheral target without disengaging attention, whereas in the overlap condition participants must first disengage attention from a central stimulus. Slower latency to fixate on the peripheral target in the overlap condition reflects slow attentional disengagement. Preliminary data at the first time point in a larger longitudinal study were collected from 9 TD participants (8 male, mean age = 34.50 months, mean MSEL DQ = 109.25) and 15 ASD participants (14 male, mean age = 38.02 months, mean MSEL DQ = 70.26). As expected, the delay of overlap fixation latencies relative to gap fixation latencies was greater in ASD than TD, Welch's $t(21.62) = -2.30$, $p = .03$. These preliminary results are highly consistent with prior research on attention in ASD and support the present longitudinal study's aim of exploring trajectories of attentional disengagement over time and their relation to other aspects of the ASD phenotype.

Using Chemistry to Determine how DNA Repair Enzyme MutY Finds its Target Damage: Testing the Stability of Analog Substrates of MutY

Kaylena Principe
Sponsor: Sheila David, Ph.D.
Chemistry

DNA repair is crucial for the survival and prosperity of all oxidative organisms. One of the most commonly formed types of DNA damage, 8-oxoguanosine (8-OG), is paired erroneously with adenine (A) in our cells. The base excision repair (BER) pathway excises the mismatched DNA base adenine using enzyme MutY. MutY specifically targets the 8-OG:A mispair, and specifically cleaves adenine rather than the damaged nucleobase, 8-OG. It was previously determined by our lab that the 2-amino of 8-OG was crucial to MutY's recognition mechanism. The structural features of the 8-OG:A mispair allow for MutY recognition and repair, which is why modifications of the exocyclic amino group are pertinent to our understanding of the MutY recognition mechanism. Our laboratory is focused on the synthesis of modified analogs of 8-OG. We will synthesize various analogs of 8-OG that vary in hydrogen bonding and steric effects at the 2-amino, and we will then see how well these analogs are repaired by MutY. Reported herein is the duplex stability studies of these modified 8-OG:A base pairs. These studies help further characterize and analyze the modified analogs, and further our understanding of the properties of the 2-amino group that enable MutY target recognition.

Novel Methods for Identifying Underrun Heels in Horses

Raquel Providell Appenfelder
Sponsor: Susan Stover, D.V.M.,Ph.D.
VM: Surg/Rad Science

A novel approach to redefine the methods for identifying abnormal hoof conformation in horses was conducted and tested. It is generally accepted that a difference greater than 5 degrees between toe and heel angles of the hoof is considered to be underrun hoof conformation. In an effort to further define underrun heels, measurements of hoof area and angles along the hairline above the hoof were measured and compared to hoof angles to determine a correlation between measuring techniques. The correlations between the hoof area and hairline angles to wall angle differences were weak. However, strong correlations were found between the total foot area and the palmar hairline angle as well as between dorsal and palmar hairline angles. As the coronet angles increased, total hoof area also increased. The use of these novel approaches to determine whether a hoof is underrun were not found to improve upon currently accepted measurement standards.

Risk and Resilience Factors of Maternal Depression: Economic Hardship and Social Support

Rosa Pumacayo
Sponsor: Leah Hibel, Ph.D.
Human Ecology

This study focuses on first time Latina mothers, who are at risk of symptoms of depression. It is important to understand these mothers because depression can be a critical disruption to their interaction with their infants. Depression can make mothers experience loss of interest in their daily life activities. Economic hardships are a risk factor of depression that gives stress to mothers who need to make ends meet. Another factor is lack of social support that increase depression. Not receiving support leads to poor interaction between parents and infants. Few studies examined the relationship between economic hardships, lack of social support, and depression. These analyses utilize data from California Babies Project at UC Davis where forty Mexican American mothers of 6 month old infants participated. They were 22 years, with an income between $25,000 to $30,000. Mothers filled out the questionnaires during interviews. In order to examine, we used three variables. The independent variables were the economic hardships and lack of social support. The dependent variable was depression. We found an association between economic hardships and depression, such that mothers reporting greater economic hardship also report higher depression. Similarly, mothers reporting lack of social support experience and increase depressive symptoms.

Effects of a Record-Breaking Heatwave on Mussel bed Communities in Northern California

Jenna Quan
Sponsor: Eric Sanford, Ph.D.
Evolution & Ecology

Heatwaves are projected to increase in frequency due to anthropogenic climate change. Past studies indicate that these disturbances can trigger mass mortality of sessile intertidal foundation species such as mussels. However, little is known regarding how mussel mortality influences the community within the beds. In this study, we documented the consequences of mass mortality of California mussels (Mytilus californianus) in association with a record-breaking heatwave that struck northern California during June 2019. We surveyed the percentage of mussel mortality in randomly placed quadrats in Bodega Marine Reserve and compared composition of invertebrates within plots with low versus high percentages of dead mussels. Mean mortality of mussels in the upper layer of the bed was 30.4% in the high zone, and 24.1% in the mid zone. Shannon-Wiener diversity indices did not differ between plots with a high percentage of dead mussels and those with a low percentage of dead mussels; however, the plots with a high percentage of dead mussels had lower species richness and lower total abundance of invertebrates. These results demonstrate that heat waves can have immediate, negative effects on mussel bed communities. Additional research is needed to examine recovery rates and the longer-term impacts of these extreme events.

Development of a Rabbit *ex vivo M*odel for Evaluating Biophysical Interactions at the Ocular Surface

Melinda Quan
Sponsor: Brian Leonard, D.V.M.,Ph.D.
VM: Surg/Rad Science

Corneal mucins are large glycoproteins extending from the apical surface of the epithelium and have been shown to improve the “pinning” capabilities of a droplet on the surface of corneal epithelial cells in vitro, known as hysteresis. Previous experiments used stratified human corneal epithelial cells grown on glass slides, however, natural corneal contour is moderately curved, representing another dimension of complexity in studying factors affecting the tear film covering the corneal surface. This project focused on developing the tools to measure contact angle and surface hysteresis with rabbit globes ex vivo. Whole rabbit globes were fixed to glass slides and a droplet of perfluorodecalin was placed on the apex of the upward facing cornea. Dynamic tilting goniometry was performed to measure ocular surface hysteresis using the advancing and receding contact angle in the following equation: cos Trec - cos Tadv. Using this equation, the hysteresis of the rabbit globe was 1.086, similar to that of human corneal epithelial cells in vitro. This represents the first time a curved structure has been used to assess corneal hysteresis in an ex vivo and serves as a relevant and reliable model for evaluating potential therapeutics to promote better tear film stability.

Broken Promises and Misplaced Anger: Aggrieved Masculinity Among Young Men Online

Joselyne Quiroz
Sponsor: Laura Grindstaff, Ph.D.
Sociology

For twenty years, male rage has been the catalyst in mass shootings throughout the United States. While gun violence is not new in this country, newer mass shooters are distinct in their use of manifestos to explain and justify their actions, which they write with a national audience in mind. When approaching the problem of mass shootings, social scientists have focused on the shooters’ individual circumstances, like their upbringings or medical histories. This project shifts focus from the individual to the collective by focusing on one online space that mass shooters have frequented, the involuntary celibacy (incel) community, in order to explore the role such communities play in decisions to commit or justify mass violence as a way to cope with their suffering. This paper analyzes how online spaces are productive forums in cultivating and enacting aggrieved masculinity by conducting content analysis on the manifestos and final writings of ten mass shooters, as well as posts from popular incel website, incels.co. Preliminary findings demonstrate that much of the writings from manifestos and incel forum posts are devoted to justifying their acts of violence or controversial beliefs and also spend much time describing the isolation and pain they endure.

Youth of Color in Depth and in Jail

Stephanie Quero
Sponsor: Ofelia Cuevas, Ph.D.
Chicano Studies

The pathway of crime for juveniles in California is not as simple as getting arrested, charged, then released as there are other factors involved such as public defender fees, administrative fees, and lasting consequences. This research assess how the higher rates of incarceration, arrests, and probation affect Black and Latinx juveniles. This research will examine how the disproportionate effects on Black and Latinx youth in the juvenile system affect them and their families. In addition, this research will assess the pathway of crime and how it imposes unnecessary fees that disproportionately affect Black and Latinx youth facing the justice system than it does to White youth. I will be analyzing this because it is important to assess the barriers in place that make it more difficult for individuals to go through the pathway of crime. The pathway of crime includes the option of bail, yet, those who cannot afford it are subject to paying jail fees that causes for further debt and criminalization. Nevertheless, this research proposes feasible solutions that can be implemented to allow for equity among Black and Latinx juveniles that will minimize or fully eliminate the disproportionalities they have compared to White youth facing the justice system.

Optimizing Sterile Isolation of Exosomes from Cultured Cells For Alzheimer’s Disease Research

Lily Rahnama
Sponsor: Anne Knowlton, M.D.
MED: Int Med Cardiology (sac)

Alzheimer’s Disease (AD) has affected 5.8 million Americans and 10% of people aged 65+ are expected to develop it. AD causes memory loss, disturbances in daily functioning, and ultimately, death. The development of effective therapies for AD has not been successful. All cells release exosomes, which are vesicles that facilitate communication between cells. We hypothesize that systemic exosomes released by senescent (sen) endothelial cells in aging people can cross the blood brain barrier (BBB) and adversely affect neural cells by delivering pro-inflammatory cargo. Analyzing exosomes released by endothelial cells can provide new insights into AD and potentially lead to new therapeutic approaches. To begin to study this, I developed a sterile isolation procedure for exosomes derived from the media of cultured endothelial cells. I used ultrafiltration to concentrate the sample, size exclusion chromatography (SEC) to isolate exosomes from that sample, and western blot analysis to evaluate protein content. I ran a polymerase chain reaction to test for mycoplasma contamination and an agar bacteria test to ensure the SEC column and samples were sterile. Currently, control (early passage) exosomes have been successfully extracted and analyzed. Each test confirmed sterility in this extraction process.

The Landscape of the Digital Healthcare Transformation: Evolving Patient Preferences and Emerging Consumer Markets

Kajal Raju
Sponsor: Dalia Ghanem, Ph.D.
Ag & Resource Economics

As traditional healthcare systems become financially unstable in the face of rising prevalence of chronic disease, increasing costs of treatment, and doctor shortages on a global scale, digital healthcare platforms and telemedicine are lauded as revolutionizing the healthcare industry. While digital healthcare can potentially provide significant benefits to those who utilize it, the question of who is able to utilize digital health technology prompts broader questions of accessibility and consumer preference. A digital health platform's benefits are recognized when a patient is able to seamlessly incorporate the technology into their lifestyle. "Seamless" incorporation takes on different meanings in different patient contexts. This econometric study analyzes consumer-level telemedicine preferences within the framework of state-level trends on the demand side of the US digital healthcare market. The purpose of this study is to capture the current landscape of the emerging digital healthcare market, and create a business case for outreach efforts and user experience considerations for communities with differentiated preferences for telemedicine.

Research: Using Design to Make Research Papers Accessible

Kausalya Raman
Sponsor: James Housefield, Ph.D.
Department Of Design

Resea is a website that aims to present currently relevant research papers in a well-designed, easy to understand format, with simplified, non-academic, and unbiased language. Research is the driving force behind much positive change in the world, and many impactful research papers are published every year. However, this research tends to exclusively be targeted towards an academic audience, and is inaccessible to many others, from voters of varying education levels, to customers of businesses that claim to be backed by research in order to mislead, to aspiring activists who are asking questions that research may have already answered. This project aims to answer the questions: Is there a way to use design to make important research more accessible to the general public? Would increasing access to such research push innovation forward at a faster pace? The deliverables for this project include the design of the website with a focus on Economics research papers that are currently relevant to policy issues being debated leading up to the 2020 elections, and user research and testing in Economics classrooms.

Generation of a Smooth Muscle Specific cAMP Reporter Mouse

Victoria Ramer
Sponsor: Madeline Nieves-Cintron, Ph.D.
MED: Pharmacology

Arterial myocytes receive many inputs from sympathetic nerves that regulate vascular reactivity by activating G protein-coupled receptors (GPCRs). The ubiquitous second messenger 3',5' monophosphate (cAMP) is synthesized by different adenylyl cyclase (AC) isoforms in response to the activation of various GPCRs. cAMP is thus critical for integrating and relaying the myriad of signals elicited by GPCR/AC activation. For instance, cAMP production regulates critical cellular events in arterial myocytes, including growth, differentiation, relaxation, and excitability. Even though cAMP signaling is critical for arterial myocyte function and vascular physiology, little is known about its regulation in an in vivo. This is due in part to the scarcity of appropriate tools and approaches to examine these properties. Here we report the generation of a genetically-engineered mouse that expresses a FRET-based cAMP sensor specifically in smooth muscle cells (Camper mouse). This mouse facilitates the recording of cAMP signals in response to different stimuli as well as the concurrent recording of arterial myocyte contraction/relaxation events. This novel approach will allow us to study cAMP signaling regulation on arterial myocytes in an in vivo setting under physiological conditions and in disease.

Baby/Toddler Multiuse Resizable Shoes

Cristhofer Ramirez
Sponsor: Gozde Goncu Berk, M.D.
Department Of Design

Modern households with toddlers know that their apparel is not just important but also the actual period of use is very short. Footwear, to be more specific, is something that parents are always concerned about because they have to purchase shoes every 2 to 3 months approximately. In our research, we conducted interviews with people with children of 1 to 5 years of age. They noted that the first months, and years especially they find themselves going into a shopping center buying new shoes for their child at least 3 times a year; therefore, we found a solution that will not only help parents' pockets but also help the damaged environment. We've come up with a shoe that can not only fit the toddler for up to 3 years but also it's 100% sustainable, so the shoes will be 100% recyclable. We not only focus on trying to make shoes resizeable as the child grows but also in making it comfortable, fitting and multiuse, for different seasons. Ergo, in an effort to reduce waste and save parents' time and capital, I believe the product solves a problem that parents and the world would be thankful for.

Using Risk Analysis Modeling to Better Understand the Movement of Virulent Newcastle Disease in Backyard Poultry in Southern California

Katherine Ramirez
Sponsor: Maurice Pitesky, D.V.M.
Anr Vm Population Hlth&reprod

Virulent Newcastle Disease (vND) is a detrimental poultry disease that can cause serious economic and health repercussion when outbreaks occur. Southern California has witnessed two major virulent Newcastle disease outbreaks and is currently dealing with containing its third outbreak. Over $217 million were spent during the eradication of vND in the 1971 and 2002 outbreak which has led to the need to find effective methods of disease prevention. This study will analyze previously collected data on backyard poultry movement and construct Susceptible- Infected- Recovered (SIR) models to depict the flow of disease transmission. SIR epidemiological models can help us determine potential disease transmission like between backyard and commercial farms due to their proximity to one another. These SIR models will then be analyzed to help determine the impact of different disease parameters (i.e. transmission rate, between premises/ contact rate, mortality rate, vaccination fraction). Applications of this study include communicating risk of disease more effectively to poultry stakeholders and implementing effective disease control/prevention methods. It may be that vaccination is a key parameter when deciding control/prevention methods of virulent Newcastle Disease, thereby placing a need on educational outreach to the public to ensure proper vaccination of poultry.

How do Type 1 Regulatory Cells Modulate HIV Viral Load?

Niharika Rane
Sponsor: Smita Iyer, Ph.D.
VM: Pathology, Micro, & Immun

Type 1 regulatory cells (Tr1), a subset of antigen-experienced CD4+ T cells, are induced following chronic T cell receptor signaling. Tr1 cells regulate inflammation and cellular immunity during chronic viral infections such as HIV. Notably, Tr1 cells suppress viremia through Granzyme-mediated cytolysis, while concurrently inhibiting viral clearance via IL-10, and CTLA-4 mediated contact inhibition. Yet, relatively little is known about Tr1 differentiation in germinal centers, sites of active HIV replication. We hypothesize that chronic antigen stimulation and corresponding immune activation of Tfh CD4 T cells induces their differentiation to Tr1 cells. Our objectives are to identify peripheral Tfh cells expressing Tr1 markers during HIV infection. Using longitudinal human PBMC samples from the California HIV/AIDS Research Program, our goals are to characterize Tr1 cells in HIV infected patients with variable ART regimens. We will evaluate samples with sustained high (>100,000 copies/mL) and low plasma viral loads (<200 copies/mL). Tr1 cells will be identified as Foxp3-CD25-LAG-3+CD49b+ with high IL-10 secretion together with CXCR5, the canonical Tfh marker, using multiparameter flow cytometry. The resulting data will provide insights into the regulation of the germinal center response and pave the way for the design of HIV therapeutics.

Fight Club on the Lek: Understanding Patterns of Male-male Aggression in Greater sage-grouse *(Centrocercus urophasianus)*

Anna Rankin
Sponsor: Gail Patricelli, Ph.D.
Evolution & Ecology

Greater sage-grouse (Centrocercus urophasianus) are an iconic member of sagebrush ecosystems across western North America. During the breeding season (March-May), males gather on communal breeding grounds called “leks” where they engage in breeding displays to attract female and defend territories from rival males. Although previous studies have analyzed the high energetic costs of lek display, particularly during very low temperatures and showed that male grouse can alter display rates with the approach of females, little work has been done to analyze potential trade-offs associated with male-male aggressive behaviors. We collected data using motion sensitive cameras placed on eight different lek sites In California’s Eastern Sierra from early March to late May. We analyzed the incidence of male-male aggression as correlated with both ambient temperature and overall female attendance. We expect incidence of male-male aggression to positively correlate with ambient temperature and negatively correlate with female attendance due to associated energy tradeoffs. Given that sage-grouse are a near-threatened species, they are of particular conservational concern, and a fuller understanding of the temporal scope of their lekking behavior may offer significant conservation application.

Exploring Variations in Plant Defense Compounds from *Arabidopsis thaliana* Based on Geographical Differences

Alycia Rasmussen
Sponsor: Daniel Kliebenstein, Ph.D.
Plant Sciences

Glucosinolates (GSLs) are defense metabolites found throughout the Brassicales, including cabbage and horseradish, which are toxic to attacking insects and bacteria. In addition to aiding plants, GSLs act as antioxidants and anticarcinogens in humans. GSLs have many different chemical structures and our goal was to see if different environments are responsible for affecting these structures in Arabidopsis thaliana. We are focusing on the seven short-chain aliphatic GSLs, which are GSLs that derive from the amino acid methionine and have up to four carbons. Prior to this project, we extracted GSLs from seeds of A. thaliana populations across the world, and created a unique GSL profile for each population. From these results, we determined which of the seven GSLs was dominant for each population and then mapped where each was found geographically. Our aim is to explore the connection between GSL structure and where it is found geographically. As the sequencing data for these populations is available, we will combine that data with our results to better understand the history and evolution of A. thaliana.

The Factors Affecting Social Cognition in High Functioning Children with Autism

Anysa Razaghzadeh
Sponsor: Peter Mundy, Ph.D.
Education

Social cognitive problems may impact learning in children with autism who have IQs in the typical range and are in regular education classrooms. However, research suggests that these problems may only occur for higher functioning children with low-typical verbal IQ (VIQ). Therefore, this study examined the social cognitive abilities of students with autism with higher and lower VIQs. The study also investigated the relations of executive functions and inferential thinking to social cognition in autism. Participants included 72 children with autism (VIQ > 74) and 40 VIQ- and age-matched (age 8-15) typically developing children. The results indicated that children with autism displayed social-cognitive difficulties compared to peers. The evidence was stronger for children with lower VIQs, but was still significant for children with higher VIQs. Differences in social cognitive problems were also related to differences in working memory and inferential thinking problems, but only in the autism sample. Problems in social cognition, working memory, and inferential thinking correctly characterized 71% of the autism sample. The results of this study suggest that problems with social cognition, working memory, and inferential thinking may be important to address in education for students with autism who are not affected by intellectual disability.

Product Development of a Color Changing Healthy Alternative Pastry Snack for Kids Using Upcycled Ingredients

Andrew Reagan
Sponsor: Alyson Mitchell, Ph.D.
Food Science & Technology

In recent years, the awareness of healthy life-style choices and rapid growth in food allergies has increased in children and their millennial parents which impact the food industry. To address this, we developed a convenient, innovative and healthy snack that is safe for food allergic kids, while aiming for sustainability. Chameleon Doodle Pockets are a color changing pastry that can be drawn on, and are known for having high fiber, protein, vitamin C and made with upcycled ingredients while focused on health-conscious millennials who have children. The combination of our gluten free flours offered high Vitamin A and calcium while displaying an elegant aroma. The fruit filling made with elderberry, watermelon rind and banana peels contained notable vitamins, phenolic compounds and flavonoids which have pronounced positive effects in vitro. Kids were influenced by the color-changing effects in anthocyanins found in purple sweet potato, that changed from dark purple to bright pink when a low pH transparent gel pen was applied to the pastry. Choose All That Apply (CATA) test results indicated kids enjoyed the fruity, sweet, and chewy characteristics of our product. 9-point hedonic and JAR scale indicated kids preferred our product over Kellogg's pop tart.

The Role of Myth-Making in Modern Fantasy

Megan Reeve
Sponsor: Matthew Vernon, Ph.D.
English

Modern fantasy often employs references to ancient mythology, be it Norse, Greek, or Roman. These stories often become sources themselves, spawning fan fiction and modern myth-making of their own. This project focuses on the ways stories and motifs from ancient cultures are carried over, changed, and repurposed in the modern fantasy series The Lord of the Rings and Harry Potter. Why did Tolkien and Rowling find it necessary or helpful to 'return to myth'? I start with trying to understand the status of myth in relation to history, storytelling, and memory as sources of truth within the story. This will then affect how we can read each of these series as myths of contemporary society that have spawned reams of storytelling and myth-making of their own. This will also clarify what kinds of reading are advocated in each series as they deal with the presence of myth and the truth-value of storytelling as compared with other forms of knowledge, such as the scientific method or scientific skepticism.

Body Size Evolution in Hawaiian Drosophilidae

Dawn Reynolds
Sponsor: David Begun, Ph.D.
Evolution & Ecology

Adaptive radiations occur when novel ecological conditions create new opportunities, driving a single species to diverge into many new species rapidly. The Hawaiian Drosophilidae, consisting of flies in the genera Drosophila and Scaptomyza, is both physically and ecologically diverse. Limited to a land area of just 16,700 square kilometers, Hawaiian ecological communities provide a model system for studying rapid adaptive speciation resulting from colonization millions of years ago. Although Hawaiian Drosophilidae species are known to vary dramatically in body size, evolutionary patterns of body size within the family are not well understood. The University of Hawaii Insect Museum is a research institution with over 25,000 Drosophilidae specimens. We are utilizing the specimens for analysis of evolutionary trends in body size in relation to potential life history traits, including breeding substrate, altitudinal gradient, and sexual selection. Preliminary results show a difference in size between sexes of Drosophila and Scaptomyza species, potentially indicative of higher sexual selection pressures in Scaptomyza. We expect evolutionary patterns of life history traits to show relationships with body sizes of Hawaiian Drosophilidae. By learning more about body size evolution, we can infer more about how speciation, especially on such a rapid time scale, occurs.

Assessment of Growth-Stage-Dependent Sprays of MBI-505 on *Oryza sativa*

Trina Reynolds
Sponsor: John Yoder, Ph.D.
Plant Sciences

MBI-505 is a product developed and sold by Marrone Bio Innovations. It is currently sold on the market as a plant stress reductant. In particular, it is known to protect plants from UV rays in sunlight. However, further experiments have produced data that suggests that MBI-505 is doing more in the plant than originally expected. An experiment on wheat conducted by the company found that applications of MBI-505 increased grain weight, root growth, and yields. However, the effects of MBI-505 appear to be growth-stage dependent. In order to investigate this observation further, Oryza sativa (rice) plants were sprayed with MBI-505 at one of four growth stages: early vegetative, late vegetative, flower initiation, or senescence. After senescence, the plants were harvested. Spike, grain, root ball, and vegetative biomasses were determined. Then, harvest indices were calculated for each treatment and the root systems were analyzed using WinFolia software. This information will increase the effectiveness of MBI-505 application and use by farmers. The company can now advise farmers which growth stage to spray at in order to maximize the positive effect on yield.

Investigating the Role of NRAMP1 Mediated Metal Starvation in Neutrophils During Infection by *Salmonella* Typhimurium

Aranza Reynoso
Sponsor: Renee Tsolis, Ph.D.
MED: Medical Microbiology & Imm

The innate immune system controls infections by pathogens in part by starving them of metals essential for their growth - a process termed Nutritional Immunity. Macrophages and neutrophils are the first responders to bacterial infections. It is known that macrophages express a metal transporter termed Natural Resistance-Associated Macrophage Protein 1 (NRAMP1) that limits microbial access to iron and manganese. Neutrophils also express this transporter and we hypothesize that NRAMP1 plays an analogous role in neutrophils. To test this, we created mutant strains of Salmonella Typhimurium (S. Typhimurium) that cannot compete with NRAMP1 for metals because they lack genes important for iron and manganese uptake. We will test the ability of these mutants to survive inside of mouse neutrophils that express either a functional allele or a non-functional allele of NRAMP1. If NRAMP1 expression in neutrophils mediates metal starvation, we predict that we will be able to recover more mutant Salmonella from neutrophils with a defective NRAMP1 allele than from neutrophils with a functional NRAMP1 transporter. These findings will contribute to our mechanistic understanding of the contribution that neutrophil derived NRAMP1 has on immunity against bacterial pathogens.

Characterization of the BRCA2 Tumor Suppressor Binding Partners, PALB2 and EMSY, in Regulating BRCA2 Multimerization

Mahssa Rezaei
Sponsor: Wolf Heyer, Ph.D.
Microbiology & Molec Genetics

Homologous recombination (HR) is a mechanism that repairs double-stranded breaks in DNA. BRCA2 is a tumor suppressor protein that functions in HR and interacts with other proteins to maintain genome integrity. BRCA2 mutations can lead to higher risks of breast, ovarian, and other cancers. Microscopic studies have revealed that BRCA2 is commonly found in oligomeric clusters, with dimers and trimers being most prevalent. Recent studies by Le et. al (unpublished data) have identified BRCA2 self-interactions that occur between the N- and C- termini, and that are regulated by different binding partners. Two of these binding partners, PALB2 and EMSY, have binding sites that overlap on the BRCA2 N-terminus. PALB2 is required for BRCA2-mediated HR and mutations in PALB2 can lead to cancer. Contrastingly, amplifications in EMSY expression have been found to suppress BRCA2 and are linked to sporadic breast and ovarian cancers. We hypothesize that EMSY and PALB2 have opposing effects on BRCA2 multimerization via their interactions with the BRCA2 N-terminus. To study these effects, we created expression vectors of BRCA2 binding domains for EMSY and PALB2 to express in E. coli. We will conduct a pull-down assay of BRCA2 to test the effects of these proteins on BRCA2 multimerization.

Sensory Motor Gating in Rats with Alexander Disease

Bita Rezaian
Sponsor: Robert Berman, Ph.D.
MED: Neurological Surgery

Alexander disease is a rare Leukodystrophy disease resulting in delayed growth along with impaired motor and cognitive function. It is the result of mutations in the glial-fibrillary acidic protein gene (GFAP). Levels of the GFAP protein are increased and abnormal protein deposits known as Rosenthal fibers are found in astroglial cells, along with destruction of myelinated white matter in the brain. In this experiment, we use prepulse inhibition (PPI) to measure the sensorimotor gating of auditory input in Alexander disease model rats. PPI is a phenomenon in which a weaker auditory stimulus, known as the prepulse, inhibits the startle reflex in response to a following stronger startle stimulus, known as the pulse. It is a test of the ability of brain-stem circuitry to control sensory input and might be expected to be impaired in leukodystrophies such as Alexander disease. We hypothesized that the Alexander disease rats would have reduced prepulse responses compared to control rats. However, our results show that while the startle response is reduced in the Alexander disease model possibly reflecting motor impairment, sensory gating appears to be intact. These results help to focus attention on those brain systems that are abnormal in this disorder.

Framing the Focus: Reporting Sexual Consent in California College Campus News Stories Before, During, and After an Attack

Sofia Rhea
Sponsor: Jeanette Ruiz, Ph.D.
Communication

The 2016 Brock Turner sexual assault case received considerable media attention, prompting a review of how sexual assault cases are reported in mass media. Specifically, analyzing the ways in which sexual assault is discussed within the media has the potential to allow for a better understanding of how issues of consent are viewed and discussed amongst populations. This research utilizes content analysis methodology to analyze how consent is framed within college campus newspaper publications from California. This research also draws strongly on media framing theory to better understand how sexual consent is framed within these newspaper articles. By using the Brock Turner case as a point in time to direct my analysis, I am able to determine if there has been a shift in the public discussion of consent at the college newspaper level. My analysis focuses on the ways in which consent is discussed in these publications as well as the ways the discussion of consent has changed in the time periods before, during, and after the Brock Turner case reached virality. These findings can be used to better understand the ways that college students view consent amongst their cohort.

Mathematical Modeling, Automated Manufacturing, and Verification Testing of Low Cost Magnetorquers for 3 Axis Control for UC Davis CubeSat Mission

Cassandra Rillamas
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS magnetorquer coil development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. In hopes to launch a platform for future Earth science based missions and offer guidance for other low-cost university nanosatellites, this presentation will discuss the optimization and manufacturing process for a single unit configuration of 1 air core and 2 torquer rods. Through extensive mathematical modeling coupled with physical testing for verification, a customized configuration can be designed and manufactured in-house. The selection of magnetorquer dimensions and materials were determined through research and analysis to meet system detumbling and desaturation requirements. To efficiently manufacture the prototype, a coil winder was designed, assembled, and programmed. This adaptive and modular coil winder is designed for reliability and repeatable prototyping. The information to create highly-customizable magnetorquer structure with a coil winding device can be utilized as tools by other universities and research institutions with little to no experience in CubeSat development by significantly lowering the barrier of entry and expanding mission scope.

Exploring the Relative Contributions of DNA Topology and Sequence on R-Loop Formation

Miriam Rivkin
Sponsor: Frederic Chedin, Ph.D.
Molecular & Cellular Bio

R-loops are three-stranded structures that form during transcription upon annealing of the nascent RNA with the DNA template strand. R-loops are a valuable subject of study due to their prevalence as universal structures in genomes. R-loops have been associated with important cellular functions in health and disease. Understanding the physical and chemical forces driving R-loop formation is therefore significant. Previous work shows that these structures are influenced by the local sequence and topology of the DNA template, though it is unclear to what extent each factor plays a part. The methods involved in this project include In Vitro Transcription (IVT) of a variety of plasmid constructs containing sequences known to form R-loops in the human genome. Comparing R-loop formation across sequences will allow us to determine the contribution of DNA sequence to structure formation. To measure the contribution of DNA topology, we manipulate the degree of superhelicity in the plasmids by inducing or removing supercoils in the DNA prior to performing the IVT assays. This project will allow for a better understanding of the foundations underlying R-loop formation.

Differential Activity of Enhancers Regulating Human Specific Duplicated Gene Families

Elizabeth Roberts
Sponsor: Megan Dennis, Ph.D.
MED: Biochem & Molecular Med

Genomic duplication events can lead to gene neofunctionalization as well as genetic redundancy. Genes contained within human-specific segmental duplication (HSD) regions are implicated in novel neurodevelopmental traits. Among HSD genes, some paralogs (duplicate copies) exhibit altered expression from their ancestral versions, despite nearly identical sequences. We aim to understand the molecular basis behind this divergent expression. We hypothesize that changes in cis-acting regulatory elements drive observed differences in paralog expression. Past work in the lab has shown differential activity between promoters of the HSD gene family DUSP22, but those of gene families ARHGAP11 and NCF1 are not concordant with expression patterns. We hypothesize that for ARHGAP11 and NCF1, drivers of differential gene expression could lie within putative enhancer regions shown to be biochemically active through ChIP-sequencing. To test this, we have generated luciferase-reporter vectors from human genomic DNA via PCR amplification and Gateway cloning. In order to examine activity levels, we will transfect vectors into human immortalized cell lines and compare relative luciferase activity. We expect different levels of activity between enhancers correlating with expression level of their respective gene paralogs. The results of this study will give insight into how gene duplication affects the regulatory landscape of a genome.

Hollywood and the MENASA Other: An Analysis of MENASA Representation in American Popular Film of the 2010s

Nia Robertson
Sponsor: Suad Joseph, Ph.D.
Anthropology

This research will analyze how Middle Eastern, North African, and South Asian individuals are represented in modern popular American film. Images of terrorists, sexualized harems, and greedy sheikhs have pervaded into the American subconscious due to the extent of their usage in the media, affecting the way that many Americans view MENASA individuals. Through visual and contextual analysis of the 50 highest-grossing films of the 2010s, the stereotypes, plotlines, and representational tendencies common in MENASA-identified characters in popular film will be examined. Secondary analysis of film casts will also be done to analyze the prevalence of MENASA actors and actresses in these popular films. I argue that colorblindness and post-racialism has led to the erasure, elimination, and/or assimilation of MENASA individuals in their representations in American popular film. The presence (or lack thereof) and tendencies of MENASA representation in popular film will shed light on the cultural understandings and views of these individuals in a self-professed colorblind and 'post-racial' America.

Archiving Iraq: The Post-Colonial Period and Occupation

Abigail Robertson
Sponsor: Omnia El Shakry, Ph.D.
History

This paper is a conceptual and historical inquiry into the temporal dimensions of memory, nostalgia, violence, and revolution as conveyed through state and counter cultural productions in Iraq. The Iran-Iraq War, from 1980 to 1988, and the 2003 occupation of Iraq represent critical historical ruptures as memory becomes a site of contestation. During the Iran-Iraq War, the Ba'athist regime sponsored public, cultural projects that constructed an interpretation of the past in the service of solidifying hegemonic power relations in the present. My analysis is unique in that it draws on psychoanalytic and queer theory, while featuring Iraq during these periods as a case to consider alternative temporalities. Given Coalitional Forces destruction and looting of archives during the occupation, scholars have limited access to archival material. I work around this lack of access by utilizing art and poetry as primary sources, creating an "unusual archive" for understanding Iraq. Art and poetry offer non-linear and non-binary spaces to examine alternative temporalities and subject formation beyond past, present, and future frameworks. I argue that material problems necessitated by archival dispossession and destruction were not just inaugurated by the occupation, rather, these questions over contested memory are a return from an earlier Ba'athist moment.

Latina/o Metabeliefs about Status Misattribution

Daisy Robles
Sponsor: Bradford Jones, Ph.D.
Political Science

"Immigrant innumeracy" is the tendency for individuals to overstate the size of immigrant populations. The notion of innumeracy is politically and socially important for at least three reasons. First, immigrant populations are commonly portrayed as threatening populations, where threat, broadly conceived, extends to economic competition, challenges to cultural identity and even national security. Second, for individuals exhibiting immigrant innumeracy, support for restrictionist and punitive immigration policy seems to be higher compared to less "inummerate" individuals. Third, individuals who are ethnically or racially connected to immigrant populations but are themselves not immigrants, likely experience or report negative outcomes if they believe immigrant status is incorrectly attributed to them, a phenomenon we call status misattribution. We examine the issue of "innumeracy" from the perspective of the "target" population. Specifically, we assess the degree to which Latina/os have metabeliefs that non-Latina/os misattribute their immigration status and explore implications of status misattribution on a number of outcome measures. Using data from several online surveys partnered with Qualtrics, we find strong evidence of "innumeracy" as well as strong evidence Latina/os believe their immigration status is regularly misidentified.

Aquaponic Systems Addressing Eutrophication by Limiting Excess Nutrients

Luisa Robles
Sponsor: Jason Gross, Ph.D.
Anr Animal Science

Poorly managed agricultural systems are directly linked to the rise of eutrophication leading to the disruption of valuable marine ecosystems. Recovery of species diversity is vital for food webs and important in limiting algal blooms which are the leading cause of oxygen depletion in aquatic environments. In order to allow habitats and species to recover, nutrients must be reduced to sustainable levels. Aquaponics systems utilizes nutrient rich water from aquaculture production to propagate agriculture. This propagation method closes the entrance point of overnutrification to aquatic ecosystems by limiting excess sources of nitrogen and phosphorus. This study aims to determine the absorption of biological nutrients from white sturgeon recirculating systems in basil aquaponic systems. Nitrogen and phosphorus concentrations in the water were measured using colorimetric techniques with the Griess assay method and the molybdenum blue method throughout a 8-week long study. The resulting relationship of agricultural denitrification capabilities will provide a useful tool in the management of eutrophic environments.

Using Narrative Interviews to Understand Chicana/o Studies Courses' Psychological Impact on Students

Ivan Rocha
Sponsor: Monica Torreiro-Casal, M.D.,Ph.D.
Chicano Studies

Chicana/o courses at the University of California, Davis besides providing students an opportunity to understand the cultural representations, values, socio-economic issues, history and experiences of the Chicano and Latino community in the United States; they intend to empower students—especially Chicana/o and Latino students—to succeed academically and successfully navigate racially hostile systems. However, little research has been done to examine the effectiveness of these courses in supporting students' psychological well-being and academic success. Therefore, the primary goal of this study was to find if there are elements in Chicana/o Studies courses that support students' psychological well-being and academic success. A total of 8 students—who had taken at least one Chicano/a Studies course—participated in this study. Participants were interviewed with a set of 11 open-ended questions. Responses were recorded and then transcribed. We tested the hypothesis that participants would identify different elements of Chicana/o Studies courses that have supported their psychological well-being and success.

Evaluation of Multiplex PCR for Simultaneous Detection of *Giardia*, Toxoplasma, Cryptosporidium, and Cyclospora in Seawater

Citlalinicue Rodriguez
Sponsor: Karen Shapiro, D.V.M.,Ph.D.
VM: Pathology, Micro, & Immun

Protozoan pathogen contamination in seawater can pose significant health threats to marine life and people. Currently there are no standardized methods for simultaneous detection of Toxoplasma, Giardia, Cryptosporidium, and Cyclospora. Our laboratory recently validated a novel multiplex PCR (mPCR) assay for detection of these four target protozoans on leafy greens. The aim of the current project was to validate this method in a new matrix (seawater) to evaluate its use for monitoring of coastal water quality. We performed systematic spiking experiments and applied the mPCR assay on 10L of seawater spiked with various concentrations of parasites. Using the mPCR assay, Toxoplasma was detected at the lowest spiking concentration (10 parasites). Detection sensitivity for Giardia was inconsistent with only low DNA amplification even at the highest spiking level (2000 parasites). Overall, the mPCR assay performed well for Toxoplasma, Cyclospora and Cryptosporidium with consistent DNA amplification at 100 parasites or lower but was not efficient for detection of Giardia. Our results validate the application of a simple, affordable molecular approach using mPCR for detection of some pathogenic protozoan parasites in contaminated seawater. Additional approaches like targeted, simplex PCR appear to offer a more sensitive method for detection of Giardia.

Diagnosis Specific Discharge Orders for the Improvement of Healthcare Quality at a Student Run Clinic

Paola Rodriguez
Sponsor: Lorena Marquez, Ph.D.
Chicano Studies

This project was created to improve the quality of healthcare for patients of Clinica Tepati. Clinica Tepati is a student-run clinic that provides primary healthcare to the underserved Hispanic population of the Sacramento area. This project allowed for the development of educational discharge orders for a variety of diagnoses. Furthermore, the discharge orders were created to account for those patients with language disadvantages. The first drafts of the discharge orders were created by medical students from UC Davis School of Medicine and California Northstate University College of Medicine that concurrently volunteer with Clinica Tepati. The first draft was then translated into Spanish by UC Davis undergraduate students that volunteer with Clinica Tepati. The collection of orders was then compiled and analyzed collectively to create a standardized template for discharge orders. Once finalized, the orders were approved by Physicians who volunteer with Clinica Tepati. To assess the efficacy of the orders, they were dispensed along with a short assessment survey. The surveys were then compiled to assess shortcomings of the orders and make adjustments accordingly. With this project, Clinica Tepati has created an extensive collection of discharge orders that will improve the healthcare experiences of the clinic's patients.

Diagnosis Specific Discharge Orders for the Improvement of Healthcare Quality at a Student-Run Clinic

Rocio Rojas
Sponsor: Lorena Marquez, Ph.D.
Chicano Studies

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Characterization of Prebiotic Utilization by a Novel Adult-Derived *Bifidobacterium* Strain Library

Sean Romeo
Sponsor: David Mills, Ph.D.
Viticulture & Enology

Gut microbes, especially Bifidobacterium species, play critical roles in host biological processes including nutrient acquisition, immunity, and synthesis of essential micronutrients. Our lab has focused on the contributions of Bifidobacterium species on the infant gut microbiome, while adult Bifidobacterium species remain understudied. In this study, over 500 bifidobacterial isolates were obtained from adult donor fecal samples and analyzed by repetitive element PCR (rep-PCR) to identify unique bacterial strains. Thus far a library of 22 non-redundant adult Bifidobacterium strains has been generated. This library presents the opportunity to explore differential growth on non-digestible carbohydrates which could act as the microorganism's primary growth substrate and potentially enhance its persistence and metabolic activity. Strains were screened for utilization of inulin and 3'-sialyllactose (3'-SL) using a 96-well plate format. Eight strains from six different subjects grew on inulin, whereas, one strain from a single subject grew on 3'-SL. Novel libraries of bifidobacterial strains allow for the discovery of probiotic strains where their prebiotic utilization could provide the rationale for the development of commercial synbiotic products.

Lies and Language: Investigating how Context can Improve the Automated Early Detection of Fake News

Noah Rose Ledesma
Sponsor: Brigitte Rabie, Ph.D.
University Writing Program

Due to the explosive growth and influential power of fake news, the demand for methods that accurately detect fake news, and intervene before it propagates, has dramatically increased. Human fact-checking cannot keep up with the quantity of disinformation entering the web. Hence automated systems have been developed. Preliminary evidence suggests that, for such systems, analyzing the text of an article alone may not be sufficient for distinguishing real from fake news. Other research has established a set of style features that are effective indicators of fake news on sample datasets. I bring these two findings together to investigate the relative effectiveness of lexical style features at distinguishing real from fake news across multiple areas of news. My research proposes questions like "Can the number of words in a sentence be used to distinguish real from fake news?" and "Is the number of words in a sentence a better indicator of real vs. fake news in politics or sports articles?" Experiments conducted using language processing software on a real-world data set of articles indicate that the effectiveness of these indicators does vary by news type. These variances could prove useful for the development of early detection systems focused on textual content.

Can Persuasive Memes Get People to Exercise? Stereotype Threat and Lift Effects on Physical Activity

Therek Romo Quevedo
Sponsor: Jorge Pena, Ph.D.
Communication

This study tested how raising the salience of stereotypes about men and women's physical prowess through memes can influence physical activity. Participants were randomly assigned to one of three meme exposure conditions (stereotype threat, stereotype lift, control) and then asked to perform a running task for ten minutes while onscreen motion-capturing avatars displayed the participant's face. Physical activity was measured with accelerometers and a heart rate monitor. Based on stereotype threat effects, we expect that exposing participants to a meme that threatens confidence in their physical abilities may decrease their cardiac frequency and step count relative to the remaining conditions. These effects may be linked to the concept of "stereotype lift" and "stereotype threat" in the context of exercise-related video games (Li & Lwin, 2015). The data was collected in fall 2019 and preliminary results will be discussed. The findings may illuminate how new technologies may be harnessed to incentivize health-related outcomes.

Factors Sustaining Bilingual Educators

Ashley Ruiz
Sponsor: Maciel Hernandez, Ph.D.
Human Ecology

Bilingual education is critical for reducing the achievement gap between dual language learners and native English speakers. However, the United States has a shortage of bilingual teachers and high teacher turnover rates. Because of the associated benefits of bilingual education for dual language learners and an increasing need for bilingual teachers to meet the needs of dual language learners, we investigated the factors that sustain bilingual teachers to stay in their profession. Through the use of focus groups, bilingual educators (N = 28) were asked about what sustains their teaching practice and keeps them in the teaching profession. Common themes that arose as primary motivators for bilingual teachers to continue being in their profession were the love that they poured into their students as well as the hope they felt that students would succeed in the future. We will discuss how these motivating factors sustain bilingual educators to remain in their profession. This research has implications for helping support current and aspiring bilingual teachers to fill the need for bilingual education in the United States.

Mental and Emotional Health Care Accessibility and the Intersectionality of Smoking in Knights Landing California

Juan Carlos Ruiz Malagon
Sponsor: Natalia Deeb Sossa, Ph.D.
Chicano Studies

Knights Landing (KL) is an agricultural town in Yolo County including a population of seasonal or migrant farm workers. Many residents of KL experience challenges accessing mental and emotional healthcare due to socioeconomic and political barriers. Within rural communities like KL, levels of anxiety and depression are typically higher due to factors such as rigid work demands, lack of transportation, exploitation, and low income. This project collected data regarding mental health conditions in KL in order to help find better methods to bring forth mental and emotional health care. An interdisciplinary follow-up health survey was validated with KL promotoras (community health promoters) and administered door to door. Two scales were used to assess mental health: the PHQ-9 scale for depression and the GAD-7 scale for anxiety. The results of this survey will be compared to a similar survey conducted 5 years ago and will be contextualized with qualitative data. Concerns relating to mental and emotional health arose during our community outreach and research possibly associated with a multitude of health disparities within KL.

Oil Price as a Trigger: Linking Oil and Human Rights Abuses

Ally Russell
Sponsor: Ethan Scheiner, Ph.D.
Political Science

Oil-dependence and human rights have become historically linked through research and historical events. Oil-dependence has been tied to authoritarianism, economic stagnation, and lack of political development, but none of these explanations on their own account for the unique makeup of oil-dependent states that links them to human rights violations. This study posits that global oil price fluctuation, rather than oil itself, acts as a trigger for periods of government-sanctioned human rights violations among authoritarian, oil-dependent states. Rather than oil as a resource creating conditions that lead to increased repression and human rights violations, as some scholars have suggested, this study theorizes that periods of oil price busts expose existing structures of inequality and capitalize on established precedents of repression among oil-dependent, authoritarian rentier states. Focusing on 22 authoritarian petro-states, I compare global oil price fluctuations and human rights scores from 1960-2016, using ordinary least squares to evaluate the relationship between oil price annual fluctuations and periods of human rights abuses.

Relationships That Matter: Impacts of Social Capital on Single Mothers in Community College

Caroline Rutten
Sponsor: Robert Faris, Ph.D.
Sociology

Between studying and parenting, student single-mothers are required to balance a great deal of conflicting responsibilities. Given the lower tuition and programs that target the population, community college tends to be a common setting for student single-mothers to pursue an education. Institutional aid that community colleges and the state provide are often perceived as the most effective ways to support the unique needs of this student group. My research aims to study another form of support — social capital — and how it impacts the experience of student single-mothers in their balance of multiple responsibilities. However, not all relationships within a student single mother's social network can be viewed as neither beneficial nor equally supportive in the same way. This research attempts to analyze which relationships within a student single-mother's social capital — between friends, parents, significant others, and community college faculty and professors — pose themselves as the most supportive and what type of support they provide. Through a qualitative analysis using in-depth interviews with eight single mothers enrolled at a community college in Northern California, I intend to contribute to the design of institutional strategies concerning how to best support this student population.

Screening and Exploring Regulatory Domains of Arabidopsis Transcription Factors

Jean Sabety
Sponsor: Patrick Shih, Ph.D.
Plant Biology

Regulation of gene expression is vital to proper cell function. Transcription factors regulate the expression of genes by binding to a section of DNA and regulating transcription of the adjacent gene. Although there is considerable interest in engineering transcription factors to build genetic circuits for various biotechnological applications, there has been little work done to characterize the domains that can tune the activation or repression of gene expression by transcription factors. Previously, we have built various synthetic transcription factors to enable the tuning of transgene expression in plants. We have characterized a library of candidate regulatory domains that modify gene expression in order to expand our ability to modulate expression with our synthetic transcription factors. Continued research into the functional domains of these domains will provide insight into how mutations in the genetic code can lead to transcriptional activation and repression, and thus modify gene expression. Uncovering this information will both improve our understanding of plant systems, and further the foundational knowledge needed for plant engineering.

Ethical Dilemma of Smart Transportation: Engineering the Future of Automated Vehicles

Rithik Sachdeva
Sponsor: Daniel Sperling, Ph.D.
Inst Of Transportation Studies

The car was first mass-produced in 1908, with the guiding principle to solve the basic mobility challenges of going places faster. The modern age has added a status symbol to the vehicle, warping it into the stratified model of luxury and affordable vehicles. And now the future of transportation has completely moved away from the question of a time-efficient commute to how transportation can integrate technology that can take over mundane tasks around vehicle navigation like lane centering, collision avoidance, automated parking, and in near future offer full self-driving capabilities. It is imperative to understand key questions related to the future of mobility such as moral and ethical dilemmas and socioeconomic impact. In our research, I am looking into liability issues of self-driving vehicles involved in accidents and the challenges in unequivocally establishing the fault. The process by which the hardware and software components are designed, assembled and deployed by dozens of ancillary companies, imply that liability laws are not keeping pace with the technological innovation happening in the transportation industry. Furthermore, I will link the socioeconomic impacts of the smart modes of transportation, from vehicle ownership, insurance, parking, and maintenance to the extremely complex liability issues.

Using CRISPR Interference to Understand the Roles of Novel *Giardia* Kinesins

Natalie Salazar
Sponsor: Scott Dawson, Ph.D.
Microbiology & Molec Genetics

Giardia, a unicellular protist, causes diarrhea with a global incidence of 100 million cases annually. With eight flagella and a ventral disc, the microtubule-based cytoskeleton is important for motility and for attachment to the epithelium of the host intestine. The assembly and functionality of these microtubule-based structures are regulated in part by a family of microtubule motor proteins called kinesins. Giardia has 24 kinesins representing all conserved kinesin families. Previous studies have shown that Kinesin-13 and Kinesin-2 influence the length of Giardia's flagella. To determine the cellular roles of other representative Giardia kinesins, we used CRISPR interference (CRISPRi) to repress kinesin transcription. For each kinesin, we designed and tested several guide RNAs and created stable CRISPRi knockdown strains. Fluorescence microscopy was performed to screen for cytoskeletal defects. Mutants were analyzed for aberrations in morphological and physiological properties such as disc structure, beat waveform, attachment, and flagellar length, and phenotypic penetrance was scored for each knockdown strain. Knockdown of GL50803_14070, a member of a novel kinesin family, resulted in defects in disc structure, flagellar function, and cytokinesis. This implies that novel Giardia kinesins have evolved conserved cytoskeletal functions.

Atlas of starch-sugar dynamics in potato (*Solanum tuberosum* L.) from in vitro to in vivo

Andrew Saluna
Sponsor: Diane Beckles, Ph.D.
Plant Sciences

Potato is the 4th important crop worldwide, serving as a staple food for human beings. Starch plays a critical role in plant growth: it is the major reserve in storage tubers, it buffers energy demand at night by its degradation into sugars, and may protect against environmental stress. Starch is made from photosynthate; in autotrophic tissues starch follows a diurnal pattern of accumulation, while in heterotrophic tissues, it is synthesized continuously through development. Potatoes are asexually propagated, and in vitro growth on tissue culture is widely used as a platform for micropropagation and genetic engineering. The in vitro plantlet is very different from the plantlets cultivated on soil i.e. in vivo. The in vitro plantlet obtains sugars from media and growth may not be solely dependent on photosynthesis. The starch-sugar dynamic in developing tissue-culture plantlets and in plantlets switched from in vitro to in vivo growth are under investigation. The aim of this study is to profile the temporal-spatial maps of starch-sugar dynamics in three potato cultivars, from in vitro plantlets to in vivo mini-tubers, by using iodine visual markers and biochemical measurements. Results from this study might provide a baseline for further starch related research in potato.

Determining the Molecular Interactions of the Human Drug Transporter P-Glycoprotein with Cancer Drugs Involved in Chemotherapy-Induced Peripheral Neurotoxicity (CIPN)

Cristela Samaniego
Sponsor: Sascha Nicklisch, Ph.D.
Environmental Toxicology

Chemotherapy-induced peripheral neurotoxicity (CIPN) is the most common adverse side effect of cancer treatment that can lead to permanent pain and loss of sensation in hands and feet. The substances known to cause CIPN can be divided in several subgroups with different mechanisms of action, including platinum-based compounds, taxanes and protease inhibitors. Cumulative exposures and mixtures of these substances can further aggravate CIPN. In the central nervous system (CNS) and peripheral nervous system (PNS), the multidrug-resistance transporter P-glycoprotein (P-gp) is the major determinant of drug and xenobiotic uptake. However, P-gp has lower expression levels in the blood-nerve-barrier of the PNS as compared to the CNS blood-brain-barrier. The aim of this study is to determine the molecular interactions of human P-glycoprotein with chemotherapeutics known to cause CIPN. Using purified protein, we will test the hypothesis that single compounds and/or binary combinations can block P-gp, thus allowing them to enter the PNS to promote CIPN. We will clone, express and purify P-gp, and determine the interactions with 3-5 selected CIPN-causing chemotherapeutics using an ATPase activity assay. The results of this project will identify CIPN chemicals as substrates or inhibitors of human P-glycoprotein and inform co-administration protocols that could alleviate CIPN.

Phenotypic Traits of Plantago lanceolata as Related to Density and Demography

Ava Samuels
Sponsor: Jennifer Gremer, Ph.D.
Evolution & Ecology

This project is a continuation of a study on the globally-distributed perennial plant Plantago lanceolata that has been conducted annually since 2016. This study uses the protocol of Plant Pop Net, an international project, which aims to understand the factors driving the spatial dynamics of plant populations in response to climate change using data from P. lanceolata populations around the world. At our site in Davis, CA, we measured the abundance and phenotypic traits of P. lanceolata for four years. The trait data includes floral characteristics, phenology, morphology, and signs of herbivory. Using this data, we want to investigate leaf area as a measurement of plant size as well as compared to rosette density. We would like to explore what affects plant size and density have on survival and reproduction. In previous years, we have found relationships between plant size and density to be significant. We would like to further examine these relationships through comparison with past data from our site.

Influence of Migration on the Reproductive Success of Seabirds

Marlena Sanchez
Sponsor: Joshua Hull, Ph.D.
Animal Science

Migration and reproduction are the most energetically costly life stages for birds. The aim of this study is to examine the effects migration may have on the reproductive success of seabirds. Given the physical constraints that come with migration, research has found that there is a decline in body condition of multiple species of birds. This can affect reproductive success during the breeding season and thus, long-term fitness. Without the negative physiological effects of migration, resident populations may have the fitness benefit of not needing to recover any loss to their body condition unlike those that are required to migrate. Data gathered through a meta-analysis of seabird literature can be used to determine if there are differences in fitness between the migrating and residential populations. It is predicted that there will be a pattern which suggests the residential populations will have the overall higher reproductive success in terms of fledgling success than those that are required to migrate.

Commensal gut *Enterobacteriaceae* Protect Against Carbapenem Resistant Klebsiella Pneumoniae

Stefanie Sanchez
Sponsor: Andreas Baumler, Ph.D.
MED: Medical Microbiology & Imm

Carbapenem resistant Enterobacteriaceae (CRE), such as Klebsiella pneumoniae, are the causative agent of opportunistic nosocomial infections in immunocompromised patients in healthcare settings. Because CRE's are resistant to last resort antibiotics, there are limited options to protect vulnerable patients against Klebsiella infections. Klebsiella initially colonizes the gut before spreading to the lungs which we hypothesize that pre-emptive protection against Klebsiella in the gut could prevent systemic dissemination. Previous work suggested the gut microbiota resists pathogen colonization by exerting priority effects on nutritional niches in the gut. We plan to test this by giving mice commensal Klebsiella or other Enterobacteriaceae from murine gut microbiota, then challenging them with carbapenem resistant Klebsiella. We will test the contribution of nutritional overlap by profiling sugar utilization of different Enterobacteriaceae and growing carbapenem resistant Klebsiella in spent media from different Enterobacteriaceae. By controlling the balance of gut bacteria through limiting access to carbon sources in the gut, we expect to prevent the excess growth and systemic dissemination of bacteria We expect our results are applicable to preventing opportunistic infections in different models of inflammatory or autoimmune models of disease in immunocompromised patients.

Culturing and Identification of Beneficial Anaerobic Microorganisms in Coral (*Montipora digitata*)

Tatiana Sanden
Sponsor: Jonathan Eisen, Ph.D.
MED: Medical Microbiology & Imm

Due to rising oceanic temperatures and ocean acidification, coral reefs are increasingly at risk from worldwide bleaching events. Bleaching occurs when coral symbionts, which supply their host with essential nutrients, leave the coral due to unfitting conditions. Without the symbiont, the coral is left vulnerable to disease, starvation, and ultimately death. The term Beneficial Microorganisms for Coral (BMC) describes specific symbionts that help to promote coral health. The aim of this study is to further develop and optimize culturing strategies to grow and identify BMCs using the coral Montipora digitata, specifically anaerobic microorganisms. These anaerobic symbionts rely on gases other than oxygen to support their biochemical reactions. The symbionts that had been isolated from M. digitata fragments were grown on Marine Broth Agar in an anaerobic chamber system. DNA was extracted from visible colonies and 16S rRNA genes were amplified through PCR then sequenced for identification. It is hoped that the information gathered from the identification of the M. digitata symbionts will allow us to eventually develop a probiotic that will increase the coral's resistance to bleaching.

Structural Conformations of Rice Dwarf Virus During Gene Transcription Resolved by cryo-EM Tomography

Arkady Sanderson
Sponsor: R holland Cheng, Ph.D.
Molecular & Cellular Bio

Rice dwarf virus (RDV) is a member of the Reoviridae family that transmits via insect vector and causes severe economic damage to rice production by stunting plant growth. Understanding of its transfection mechanisms via structural analysis of this virus could aid in prevention of the disease. Although the structures of RDV have been resolved by x-ray diffraction, the capsid rearrangements upon genome transcription are still not known. To aid the visualization of the individual RDV particles during gene transcription, cryo-electron tomography was employed. The RDV particles were captured in a frozen-hydrated state to preserve their most native conformation and imaged on a single tilt-axis from -70? to +70?. These images were then used to reconstruct a high-resolution 3D structure of each individual RDV particle. To optimize the resolution and the accuracy of the reconstruction, the following methods were used and results were compared: weighted back projection (WBP), simultaneous iterative reconstruction technique (SIRT), and SMAP-EM. Each method was optimized accordingly and a rigid body fitting to the x-ray structure. Real-space and Fourier transform analysis revealed that the SMAP-EM had superior Z resolution when compared to WBP and SIRT.

Identifying mTORC1 Specific Inhibitors and Assessing Therapeutic Potential

Jose Sandoval
Sponsor: Gino Cortopassi, Ph.D.
VM: Molecular Bio Sciences

mTORC1 has been the subject of much research as its upregulation has been linked to both cancer and aging. Thus, rapamycin, the mTORC1 specific inhibitor for which the protein complex is named after, has been tested as a potential cancer therapeutic and as potential therapy to increase longevity and reduces age-related disease. However, rapamycin also has immunosuppressive properties. Therefore, it is therapeutically important to identify novel mTORC1 specific inhibitors without rapamycin's immunosuppressive properties. Previously, the Cortopassi lab screened 1600 small molecule human drugs for potential mTORC1/2 binders using bilayer interferometry technology and further screened for mTORC1 specific inhibition through pS6K and AKT phosphorylation assays. The piperazine drug class was identified as a potentially novel class of mTORC1 specific inhibitors that we believe are interacting with mTORC1 at a different site (FAT domain) than rapamycin (FKBP12-Rapamycin binding domain). Analogs of the piperazine drugs have been synthesized. We now have several molecules that we believe bind to the FAT domain on the mTORC1 protein. My project is to identify mTORC1 specific inhibitors using pS6K and AKT phosphorylation assays. We will then determine the efficacy of the most potent mTORC1 inhibitors as potential cancer therapeutics in an in-vitro model of glioblastoma.

Improved Differentiation of *Bifidobacterium* Communities Using groEL Primers

Savita Sastry
Sponsor: David Mills, Ph.D.
Viticulture & Enology

Bifidobacterium is a genus of commensal Gram-positive anaerobic bacteria that may confer species-specific health effects in the human gut. Bif-TRFLP is the current approach to accurately evaluate Bifidobacterium species in communities, but the method is time consuming. A next generation sequencing amplicon approach to identify Bifidobacterium species was designed by Hu et. al (2017) targeting a hypervariable region of the groEL gene. Here, we modify the Hu et. al PCR primers to include Illumina adapters and Golay error-correcting barcodes and assess if groEL sequencing is as accurate as Bif-TRFLP in identifying Bifidobacterium species in microbial communities. To assess groEL accuracy, 21 Bifidobacterium and 2 closely related species were grown and enumerated. PCR was optimized with B. longum subspecies infantis. A taxonomic classifier was built using the chaperonin sequence database formatted for use with QIIME2 (2019.10). 10 mock communities varying evenness and diversity of 23 species were constructed. PCR confirmed a single band of amplified sequence of correct size. Despite claims by Hu et al., early efforts to construct the classifier have failed due to lack of genus specificity. GroEL sequencing remains a promising method for high-throughput Bifidobacterium species identification and quantification but requires continued optimization to confirm its accuracy.

Taking X-Rays of Students' Knowledge Structures with More Advanced Instruments: An Examination of Chemistry Students' Concept Maps

Risa Sathe
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

General chemistry is a fundamental course essential for developing a deeper understanding of topics presented in other science courses. To develop more effective teaching methods, it is imperative to find empirical and pragmatic methods chemistry educators can employ to analyze and evaluate how students learn chemistry. Concept maps are commonly used to provide educators a visual representation of students' level of understanding, help students make connections between topics, and measure changes in their understanding after any intervention. Current qualitative and quantitative methods introduce a level of difficulty in analyzing concept maps and determining an objective depiction of a large group of students' conceptualizations. In this study, concept maps generated by students at the end of the CHE 2 series were analyzed under the light of three factors: chemistry performance, math proficiency, and gender. The main goal of this study was to examine the feasibility of using Fiji Image J, a software commonly used in biology, to generate concept maps representative of large groups of students in any field and provide educators a novel synthesis of the use of R Studio and Gephi in examining students' understanding of chemistry topics in connection with gender, chemistry performance, and math proficiency.

Exploring the Anti-Inflammatory Potential of Extracellular Vesicles Derived from Human Early Gestation Chorionic Villus Mesenchymal Stem/Stromal Cells

Hannah Schmitz
Sponsor: Aijun Wang, Ph.D.
MED: Surgery

Inflammation plays a critical role in body response, tissue engineering, and regeneration. There is a growing need to explore approaches to regulate inflammation and body response to improve the outcomes of tissue regeneration and healing. Mesenchymal stem/stromal cells (MSCs) and extracellular vesicles derived from MSCs have shown promising therapeutic potential for a variety of diseases and conditions, especially in the field of immune modulation and anti-inflammation. In addition, it has been shown that human early gestation chorionic villus-derived MSCs (CV-MSCs) possess several advantages for regenerative medicine application over other adult and perinatal MSCs. In this study, we will evaluate the effects of extracellular vesicles derived from human CV-MSCs on inflammation and modulation of macrophage phenotype switch in vitro. We will evaluate the capacity of CV-MSC-derived extracellular vesicles for suppressing the M0 (unspecified) to M1 (pro-inflammatory) macrophage phenotype polarization. We expect CV-MSC-derived extracellular vesicles will be effective in regulating inflammation and macrophage function in the process of tissue engineering and regeneration.

Reducing Food Waste on Cloverleaf Farm

Daniella Schoenfeld
Sponsor: Kimberly Rodrigues, M.A.
Hopland Rec

Cloverleaf Farms is a small organic farm on the outskirts of Davis. The farm grows peaches, strawberries, blackberries, nectarines, apricots, watermelons, cantaloupes, and figs. It faces a problem of producing many imperfect fruits that go unsold and unmarketed because they do not meet traditional aesthetic standards. This in turn reduces profits and creates food waste. By conducting surveys to better understand people's attitudes towards blemished fruit, we will be able to better market this produce and address barriers that currently deter the fruits from being sold. We will work in coordination with Cloverleaf Farm to reduce food waste of “seconds” or ugly fruit via a marketing campaign to increase membership of their "Ugly Fruit Club," -- a club which sells “ugly fruit” in bulk -- and find alternative distribution networks. This project will decrease food waste on the farm, while simultaneously increasing sales revenue. This project will ultimately support economic, ecological and social sustainability.

Style-Shifting in Japanese Interlanguage: Comparing Study Abroad and Domestic Outcomes

Marina Schroder Bydalek
Sponsor: Robert Bayley, Ph.D.
Linguistics

Style-shifting in Japanese is the alternation between levels of formality in conversation. Due to its significance in Japanese pragmatic norms, learning how to select and employ these styles appropriately becomes an important component of language proficiency, especially for intermediate and advanced Japanese language learners. While students are often instructed on these speech styles in their Japanese courses, the range of speech styles they encounter may be limited. Study abroad can be an excellent opportunity to utilize these different registers more regularly, as the types of interactions and interlocutors a student would encounter will vary throughout the day, from honorific speech with instructors to casual speech with friends. Ultimately, however, individual factors play an important role in the pragmatic development of learners, both domestically and abroad. Personal motivation and habits, learner personality, and the nature of interactions learners partake in can all influence style-shifting patterns, which can enhance—or, according to preliminary results, negate—the benefits of study abroad. Using a mixed methods approach, this study examines how style-shifting patterns differ between study abroad participants in Japan and students learning Japanese at home, as well as what aspects of their experiences may contribute to these differences.

Plastic Free Oceans: Addressing Single Use Plastic Consumption in Davis Restaurants

Reece Schweibold
Sponsor: Andrea Schreier, Ph.D.
Animal Science

The presence of plastic waste in the oceans poses a major threat to marine ecosystems. Numerous marine organisms become entangled in or unintentionally ingest plastic debris. Much of the population is unaware of the consequences of single-use plastics. This project aims to investigate single use plastic consumption in local restaurants in Downtown Davis. We surveyed local restaurants about the single-use products they offer to their customers. We distinguished which restaurants use eco-friendly products, determined how they heard about them, and evaluated the effects they have had on their business. We intend to examine the correlations between education programs, both of employees and customers, with the desire for an adoption of eco-friendly alternatives. We will quantify these impacts by investigating how much plastic can be diverted by making small changes at a local level. We aim to build a local model of community driven change that can be applied to other cities to address this global problem at a larger scale.

Analysis of Genome Elimination and Mitosis in Cetromere-Based Haploid Inducers of Arabidopsis

Erin Scott
Sponsor: Luca Comai, Ph.D.
Plant Biology

The centromere is a specific region on a chromosome and is indispensable for chromosome segregation. In eukaryotes, a conserved centromere-specific histone H3 variant called CENH3 is essential for centromere specification and propagation. In Arabidopsis thaliana, a dicot model plant, crossing strains carrying CENH3 variants with a wild type results in uniparental genome elimination and generates haploid progeny. Haploids play a significant role in accelerating crop breeding. However, the centromere-based system must be better understood in order to utilize it in field crops. The current project aims to characterize optimal growth conditions for efficient haploid induction and cellular features influencing cell division using a range of available CENH3 variants. We will report the effect of variable temperature on growth, reproductive traits, and haploid induction rate using well-characterized haploid inducers. Additionally, we will present the effects of CENH3 variants on mitotic parameters, including centromere size and rate of cell division. The data collected from these experiments will be applied to generate a more efficient haploid induction system.

#ThisIsNotAMuslimBan: The Trump Administration and the Legacy of Legal and Social Signaling in Immigration Exclusion

Valencia Scott
Sponsor: Jeffrey Kahn, Ph.D.
Anthropology

In 2017, Trump's Travel Ban (Proclamation No. 9645) gained national attention for targeting predominately Muslim countries and garnered widespread criticism as a Muslim Ban. Trump's Islamaphobic public statements led opponents to challenge the Ban as a facially neutral law meant to conceal discriminatory motives. The Supreme Court asserted that Trump's order was not a Muslim Ban, ignoring Trump's public commentary as a sign of intention and upholding the Ban's claims to national security reasons became a landmark case which set a precedent for the Ban's expansion. While the Supreme Court does not consider Trump's commentary as indicative of discriminatory intent, I argue they reveal an underlying logic of exclusion that extrajudicially signal how Trump wants the public to perceive these policies and shapes how they are executed in reality. Using the Travel Ban (Muslim Ban) as a case study, I discuss the legacy of other bans like the Chinese Exclusion Act and the medicalized ban of Haitians in the 1980s. I look to how these bans were legally and socially articulated, how they were publicly received, and how they reflect a history of the racialized and medicalized logics that shape exclusionary aspects of United States immigration law.

Education and Opinions on Trade in Developed Democracies: Evidence From Survey-Level Data

Jeffrey Seidl
Sponsor: Deborah Swenson, Ph.D.
Economics

As democratic policy formation is at least in part driven by popular opinion, a deeper understanding of public views on trade in democracies has become more important than ever in an international order increasingly defined by globalization. Using individual-level survey data, this project explores demographic determinants of views on trade in select developed democracies. Specifically, the project focuses on the relationship between educational attainment and views on trade. Existing theories on the subject predict that higher-skilled individuals in advanced economies stand as those with the most to gain from the expansion of trade while those with relatively lower levels of skill are among those with the most to lose. Assuming that educational attainment is positively associated with individual skill, it is expected that those with higher levels of educational attainment in developed democracies will tend to view international trade more favorably than those with lower levels of educational attainment. Using a hierarchical linear model, preliminary results suggest that higher levels of educational attainment are indeed associated with more positive opinions on trade in developed democracies.

Returns to Education for Migrant Workers in China

Ashton Sein
Sponsor: Stephen Boucher, Ph.D.
Ag & Resource Economics

Over the past few decades, China has developed one of the fastest growing economies. One main factor fueling this growth has been rural-urban migration. Migrants face many challenges in their new environment including a wage gap i.e. migrants hourly earnings are lower than non-migrants. Human capital theory suggests that wages reflect productivity which increases due to education. This study analyzes whether the wage gap continues to exist after controlling for education. A Mincer equation is used to examine the returns to education and experience for 8,446 migrant and 14,682 non-migrant workers from the 2007 Chinese Income Household Project data. A tobit model is applied to account for the large left-censoring in the data from respondents who do not have a wage. The study estimates the coefficients on the interaction term of migration status and education while controlling for other variables such as experience, province, gender, and employment. I find that the returns to an additional year of education are significantly lower for migrants. Two potential explanations for this result are that education quality is lower in rural areas leading to lower work productivity or that education quality is similar, but there is discrimination within the labor market.

Dark Matter – Galaxy Offsets in Illustris TNG-300 Clusters

Matthew Self
Sponsor: David Wittman, Ph.D.
Physics

Conclusive evidence exists that approximately 85% of the matter in the universe is composed of an unknown substance which interacts with the known particles only gravitationally, dubbed dark matter because it neither emits nor absorbs light. Little is known about the properties of this dark matter, and a simple model known as cold dark matter (CDM) is in agreement with all existing observation. Deviations from CDM such as non-gravitational self-interactions may leave observable imprints on the distribution of offsets between clusters of galaxies and their host dark matter halos. We select a sample of 250 massive clusters in the Illustris TNG-300 large-volume cosmological simulation in a way which mimics observation. We then characterize statistical properties of various measures of galaxy-dark matter offsets expected in CDM and search for combinations of measures which could be used to constrain alternative models of dark matter by comparing with observation. We explore how offsets depend on cluster properties such as mass and relaxedness and comment on cluster populations which might be promising for future study.

Simulating p+p Collisions using Monte Carlo Techniques!

Vincent Serracino
Sponsor: Manuel Calderon DeLaBarcaSanchez, Ph.D.
Physics

Simulations of thousands of proton + proton collisions were conducted using Monte Carlo integration techniques. These simulations were performed within PYTHIA 8, a standard tool for modeling and understanding hadron collisions in High Energy Physics and using ROOT, a framework used by physicists at CERN. For each initial condition per collision we explored the wide spectra of daughter products. We gained insight about the constituent particles of the universe from the Standard Model of Particle Physics from product multiplicity and recorded physical quantities. Repeated exposure to collision simulations allowed us to begin to familiarize ourselves with Quantum Chromodynamics (QCD), the theory of interaction between quarks and gluons due to the presence of Strong Nuclear Force. QCD is an active subject of study not commonly available to students of undergraduate physics at the level of detail covered. In the resulting streams of particle decay, we learned methods of confirming particle detection in particle accelerators such as the Compact Muon Solenoid (CMS) detector at the Large Hadron Collider (LHC) in Geneva Switzerland.

Role of *CHD8* in the Cerebellum, a Study of Neuroanatomy and Proliferative Dynamics in Mice.

Jin Myeong Seo
Sponsor: Alexander Nord, Ph.D.
MED: Psychiatry & Behav Sci

Mutations in the chromatin-remodeling factor CHD8 have emerged as key genetic risk factors for neurodevelopmental disorders (NDDs) and autism spectrum disorder (ASD). Most CHD8 mutations lead to a loss of functions and carriers generally display intellectual disability, ASD-like behavior and macrocephaly. Chd8 haploinsufficiency in mice ($Chd8^{+/del5bp}$) presents similar ASD-like patterns and altered proliferative cortical dynamics. MRI studies have determined that $Chd8^{+/del5bp}$ mice have slightly smaller than average sized cerebellums amongst other anatomical brain alterations. The cerebellum is a region largely responsible for motor control and coordination. However, recent studies have highlighted the potential of this region as a model to study cell fate determination and postmitotic maturation of a single predominant neuronal cell type over the full-time course of differentiation. Here, in order to understand the causal roots of the MRI findings in $Chd8^{+/del5bp}$, link our analysis to cerebellar function, and alterations in proliferative dynamics previously described in the developing cortex, we have performed transcriptional profiling in cerebellum and studied cerebellar neuroanatomy through immunohistochemistry, looking at distribution of Purkinje cell neurons and proliferative dynamics. Our data provide new insights into the function of CHD8 in the cerebellum, an ASD-relevant region that is often overlooked across NDD animal models.

Evaluating Depth Perception in Laying Hens

Rebecca Shaffer
Sponsor: Kristina Horback, Ph.D.
Animal Science

Legislation in California has mandated that eggs sold in the state must come from laying hens housed in cage-free environments. While this change provides more space per bird and greater opportunities to perform species-specific behaviors, recent reports suggest that this housing system may result in an increased propensity of keel-bone injuries. Given that difficulty in navigating a 3-D space appears to be one source of these injuries, this study will investigate how variation in perceived platform height may impact hen behavior. Twenty-three commercial breed hens were placed in a visual cliff experiment that had a movable platform, allowing for the illusion of a cliff at 4, 8, and 12 inches deep, as well as a control of no depth (0 inches). Each hen was placed on the solid side of the visual cliff table while dried mealworms were placed on the cliff side to incentivize the movements of the hens. Various behaviors were recorded, including time spent looking over the cliff's edge and latency to cross cliff. The hypothesis of this study is that all hens will demonstrate a longer latency to cross the cliff, or not cross at all, as the perceived depth increases.

Function and Regulation of *C. elegans* BRC-1-BRD-1 E3 Ubiquitin Ligase Activity

Tara Shahrvini
Sponsor: Joanne Engebrecht, Ph.D.
Molecular & Cellular Bio

Mutations in the human breast cancer susceptibility protein, BRCA1, and its binding partner, BARD1, result in breast and ovarian cancer. The only known enzymatic activity of the BRCA1-BARD1 complex is as an E3 ubiquitin ligase, which is crucial to its role in tumor suppression. The BRCA1-BARD1 complex plays an equally significant albeit less understood role in meiosis. In C. elegans, various brc-1-brd-1 mutants, orthologous to mammalian BRCA1-BARD1, display unusual meiotic phenotypes. Using an in-vitro approach, we investigated the effects of two mutants on the E3 activity of BRC-1-BRD-1: a triple alanine (I23A, L64A, K66A) predicted ligase-dead mutant within the RING domain and the hypomorphic brc-1(tm1145) allele, resulting in a 71 amino acid deletion C-terminal to the RING domain. Preliminary data suggest that the triple alanine mutant is phenotypically null, in agreement with research conducted on the mutant mammalian protein, while the brc-1(tm1145) is predicted to have E3 ligase activity. Thus, the E3 Ub ligase activity of the BRC-1-BRD-1 complex may be insufficient for maintaining meiotic integrity in C. elegans.

Nitrogen Concentration and Source Impact on Hormones and Development in *Arabidopsis thaliana*

Emily Shane
Sponsor: Daniel Kliebenstein, Ph.D.
Plant Sciences

Nitrogen and hormones are two vital components for proper plant development. Hormones signal various processes in plants including maturation, stress response, and reproduction. Nitrogen is an elemental source of growth for the plant, while hormones utilize and regulate this input, demonstrating the critical link between the two. Differences in nitrogen sources and concentrations alter the production of several hormones in Arabidopsis thaliana. This project will develop a deeper understanding of how nitrogen indirectly impacts plant growth and function. This topic is crucial for improving agricultural and climate science applications. Localization and signaling of hormones were analyzed between several fluorescent lines of A. thaliana by using confocal microscopy. The hormones under investigation are auxin and cytokinin, while an indicator of cell cycle progression provides information about the growth rate and function of the plant. Fluorescent lines include DII Venus indicating auxin signaling, PIN1 which transports auxin, cyclin B indicating cell cycle progression, and TCSN indicating cytokinin localization. These marker lines allow visualization of the transcriptional and translational functions of these hormones responsible for plant growth.

Improvement of p-type Thermoelectric Material Ca3AlSb3 Through Elemental Substitution

Rongqing Shang
Sponsor: Susan Kauzlarich, Ph.D.
Chemistry

Thermoelectric materials are capable of producing a voltage under a temperature gradient. Real-world applications of thermoelectric materials take advantage of this unique ability by recycling waste heat from home heating, automotive exhaust, and industrial processes back into usable electricity. Material efficiency depends on the figure of merit zT ($zT = a^2 T/\rho k$) where high efficiency materials should have a large Seebeck coefficient (a), low resistivity(ρ), and low thermal conductivity (k). Optimizing a variety of conflicting properties is the Fundamental for thermoelectric materials. Ca3AlSb3 is a particularly intruiging system for the p-type semiconductor leg because of its Earth-abundant, non-toxic elements. Also, because of the complexity within the unit cell, the thermal conductivity can approach the glassy minimum at high temperature (0.6 W/mK at 1050 K). Powder x-ray diffraction data and thermoelectric properties will be presented. Further research will focus on doping the Ca with other elements for property optimization.

Stimuli-Stressor Relatedness Predicts Recognition Memory Performance after Stress

Mukul Sharda
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Evidence from prior literature indicates that acute stress after encoding increases subsequent recognition memory performance. While this effect is seen predominantly in emotionally negative items, little is known about the stimulus properties moderating the effect. To further explore the interaction of post encoding stress and valence on memory, 85 participants were shown a set of images from the International Affective Picture System (IAPS) and were asked to rate them based on five different dimensions: arousal, valence, physical pain, approach/avoidance and visual complexity. We then tested each of these dimensions against previously collected memory ratings from a cold pressor task that used the same IAPS stimuli. We found that for negative images, ratings for physical pain positively correlate with the difference in average memory confidence of stressed and control subjects, whereas none of the other dimensions demonstrated this relationship. However, for neutral images, none of the dimensions significantly predicted memory confidence which poses new questions for future research on stimuli-stressor relatedness.

Exploring the Effects of Nutritional Deficiency on the Extracellular Liver Metalloproteome

Vibha Sharma
Sponsor: Marie anne Heffern, Ph.D.
Chemistry

Metal micronutrients are tightly regulated and maintaining their biological homeostasis is essential. Dysregulation of metals such as iron and copper are associated with various disease states such as dysregulatory iron overload syndrome (DIOS) and non-alcoholic fatty liver disease (NAFLD). Despite their importance, what we know about their accumulation, transport, and function remains limited. In this work, we are identifying copper(II)-binding proteins secreted under nutritional deficiency to simulate the dynamic response of the liver under such conditions using HepG2 cells as a model system. We are implementing immobilized metal affinity chromatography (IMAC) to selectively enrich copper(II) binding proteins and subsequently using a bicinchoninic acid assay to quantify relative protein amounts over the course of the experiment. After determining the presence of any copper(II)-binding proteins, we are assessing the species via mass spectrometry. Our current results suggest that our method holds potential for identifying yet-undiscovered species in the extracellular metalloproteome.

Smartphone Distractions: Assessing Text-Message Response Time and Their Effect On Test Scores

Akshay Sharma
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Smartphone distractions are commonplace amongst university students during lectures. To determine whether providing designated technology breaks during lecture delays smartphone usage, we conducted a study which tested 84 UC Davis undergraduate students in groups of 3-10 people. Students received text-messages while watching 2 lectures, followed by lecture assessments. Each group was either given a designated technology break to check their notifications (TB, n = 40) or an undesignated break (NTB, n =44). The results show greater average testing performance for the tech break group than the non tech break group (TB_{avg} = 76.67%, NTB_{avg} = 69.07%, $p < 0.05$). Further analysis of the data revealed that this outcome occurred despite participants receiving up to 15 extra notifications during the experiment. Finally, an examination of the accuracy of test questions based upon the time they were presented in the lecture, shows that both groups have similar trends in testing performance. However, 30 seconds following the first text-message notification, the critical point when the NTB group began answering notifications, average NTB performance falls 7.6% below the TB group for the remainder of the assessments. Given these results, we suggest that employing technology breaks is a favorable strategy to delay in-class smartphone usage.

Cell Edge Retraction in Human Neutrophils Induced by Long-Range Signaling

Shashank Shastry
Sponsor: Sean Collins, Ph.D.
Microbiology & Molec Genetics

Neutrophils are early-responding immune cells recruited to sites of infection and inflammation by chemotaxis, the directed migration of cells along a chemical gradient. Once recruited to a site of inflammation, neutrophils target and destroy the invading bacteria. Importantly, loss of chemotaxis removes our immune system's first line of defense and can lead to serious bacterial infections. Chemotaxis is a complex behavior composed of cell polarization, motility, and directional sensing of chemoattractant gradients. Activation of the chemoattractant receptors biases the front/rear polarity of the cell so that the cell front is facing up the chemoattractant gradient. How chemoattractant receptor activation biases these mutually antagonistic cell front and rear programs remains unclear. Chemotaxis-stimulated, cell-edge retraction in neutrophils is mediated by the interaction of F-actin with non-muscle myosin-II. These actin-myosin fibrils are assembled by phosphorylated myosin light chains (MLCs). Rho associated protein kinase (ROCK), activated by RhoA, is a leading candidate for the phosphorylation of MLC. Alternatively, calcium-calmodulin signaling also plays an important role in generating a cell front during neutrophil chemotaxis and maintaining the positive feedback loop that maintains the cell front. In this study, I investigate whether RhoA and/or Calmodulin plays an important role in maintaining cell polarity during chemotaxis stimulated cell-edge retraction.

Effects of Eye and Eyebrow Information on Emotion Recognition

Soumil Shekdar
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Despite being the most communicative feature of human beings, emotions are not being applied while designing most of the current Human-Computer Interfaces; This is primarily due to the technical difficulty in accurately recognizing the emotional state of a person. Today, research techniques focus on facial expressions, speech patterns, and gesture movements to make inferences regarding a person's feelings. However, impracticalities of the current methods exist as there are physical and computational limitations to implementing the machine learning models that incorporate emotion recognition based on facial expressions, speech, or gestures. Recent studies show that our eyes and eyebrows dominate most of our communication of emotional states. Therefore, in this research, we propose to approach emotion recognition by training machine learning models only on the images of the eye and eyebrow. We extracted the eye and eyebrow portion of the existing datasets of facial expression images used to train current emotion recognition models, and we investigated the effect of the predictions made by Support Vector Machine, Convolutional Neural Networks, Boosted Decision Trees, and Hidden Markov Models. Our results suggested that this novel approach can be actively applied to conventional products to enhance the interaction of humans with computers based on emotions.

Sperm Count and Viability Comparison Between Insecticide- Resistant and Susceptible *Aedes aegypti* Mosquitoes

Kaiyuan Shen
Sponsor: Geoffrey Attardo, Ph.D.
Entomology/Nematology

The Aedes aegypti mosquito is an important vector for deadly human diseases such as Zika, Chikungunya, and Dengue. Their populations are controlled with insecticides; however, numerous Ae. aegypti populations have evolved insecticide resistance over time. This alarming development is a major reason why the spread of this species of mosquito has become an international predicament. This alarm is especially true in California where invasive, resistant populations have been found such as in Clovis, a small town near Fresno, However, the acquisition of insecticide resistance can have evolutionary trade- offs; for instance, research has found that the resistance phenotype is associated with reduced reproductive output. To investigate potential reproductive impacts in the resistant Clovis population, we examined sperm count and viability differences between the Clovis population and susceptible mosquitoes from the Rock control population. Examination of the sperm in the spermatheca of the female was done through fluorescent staining using the Invitrogen LIVE/DEAD Sperm Viability Kit. Sperm viability was measured at 6 time points after mating: 5 minutes, 24 hours, 72 hours, 1 week, 2 weeks and 30 days. The study aims to apply those fertility and fecundity differences to further understand the dynamics of insecticide resistance in the field.

Using Opioid Receptor Heterodimers to Combat Opiate Addiction

Sarah Sheridan
Sponsor: Jennifer Whistler, Ph.D.
MED: Physiology & Membrane Biol

Opioids are a commonly used therapeutic tool to reduce severe pain, but long term usage can lead to life-threatening tolerance and addiction. By better understanding the pharmacology of opioids acting upon their receptors, we can potentially reduce their capacity to cause addiction. The opioid receptor family consists of the delta, mu and kappa opioid receptors. Previous studies suggest that heterodimers exist between the opioid receptors. We will investigate potential dimerization between the opioid receptors by using a fluorescent sensor built from the kappa opioid receptor, capable of reporting receptor activation in real-time. The sensor's ability to reproduce similar pharmacology to the actual receptor enables us to address potential dimerization with other opioid receptors. We will study dimerization by stably co-expressing the kappa sensor with each of the mu, kappa and delta opioid receptors in HEK293 cells. We will investigate the ability of mu and delta-specific agonists, antagonists and inverse agonists to activate or inhibit the kappa opioid receptor using fluorescence of the sensor as a readout for receptor activation. Any pharmacological differences would indicate potential directions to pursue and lead new efforts to limit the addictive side effects of opioids.

Development of How Children Solve a Shape Sorter Task Between 12 and 48 Months of Age

Nikita Shetty
Sponsor: Lisa Oakes, Ph.D.
Psychology

Object insertion is an important ability that we utilize constantly in everyday life. We insert keys into locks, feet into shoes, and pieces into puzzles. While a seemingly basic skill, object insertion is actually a complex process. It requires identifying which objects and openings match, using working memory to plan the alignment and insertion of the object, and executing the motor actions to successfully manipulate and insert the object. Örnkloo and von Hofsten (2007) found that children begin to succeed at object insertions at around 22 months of age, when they begin to preadjust the objects before insertion. We examined the development of these abilities, using a more naturalistic task, in children aged 12 to 48 months. An experimenter presented the child with the shape sorter and shaped blocks that fit into its openings. We recorded the session and coded children's behavior for which opening(s) they attempted to insert each object, and how long it took them to make each insertion. The findings from our broad age range will provide us with a greater understanding of the development of children's object insertion abilities. Ongoing analyses will reveal whether children's insertions become more accurate and efficient with age.

Survival of Common Foodborne Pathogens During the Fermentation and Preparation of Kombucha

Xin Shi
Sponsor: Luxin Wang, Ph.D.
Food Science & Technology

Kombucha is a fermented drink that received increasing popularity over the past few years. Unfortunately, very limited literature information is available about the survival of common foodborne pathogens during the fermentation of kombucha. In order to fill these knowledge gaps, strains of Escherichia coli O157:H7, Salmonella, and Listeria monocytogenes were inoculated into freshly brewed black tea before adding SCOBY, a symbiotic culture of bacteria and yeast, to start the fermentation. The inoculated tea samples were kept at an ambient temperature for 12 days in order to proceed fermentation. The pH changes and the numbers of surviving pathogens were evaluated on Days 0, 1, 2, 7 and 12. Results showed that the pH of the fermented tea dropped drastically in the first 2 days (from 5.45 to 3.97) and stayed at approximately 3.5 for the rest of the fermentation process. Pathogens inoculated into the tea survived through the fermentation process without significant decrease ($P > 0.05$). These results indicate that although fermented tea beverages, such as kombucha, have antimicrobial effects over human pathogens, if pathogens are introduced into the products before fermentation, pathogens can adapt to the low pH environment and survive in these drinks for an extended period of time.

Sequencing of Microbial Isolates From Skin Swabs of the Frog, *Rana sierra*, and Their Phylogenetic Relationships

David Shih
Sponsor: Jonathan Eisen, Ph.D.
MED: Medical Microbiology & Imm

Rana sierra (Sierra Nevada yellow-legged frog) is a species of amphibian in the Sierra Nevada mountains that is under severe decline. This is due to various factors, including loss of viable breeding habitats, predation from non-native trout, and also infection from Batrachochytrium dendrobatidis (Bd), a chytrid fungus which causes chytridiomycosis, a skin disease that causes electrolyte imbalance, disrupts osmotic regulation, and inhibits respiration. This has led to the extinction of Rana sierra in over 90% of their normal habitat range. One possible method of preventing the eradication of Rana sierra due to Bd is through investigating the microbial community that is naturally present on the skin, as some bacterial isolates have been shown to have inhibitory effects upon Bd. Using skin swab samples, we isolated over 100 strains of bacteria and fungi. We have extracted their DNA and are sending the samples to be identified using Sanger sequencing. After they have been sequenced, we will sequence the genomes of the isolated strains and search for and investigate genetic pathways related to inhibition of Bd growth. This will help determine which bacterial and fungal strains show potential for preventing the eradication of Rana sierra due to the spread of Bd.

Oral History Project: Gurase Bhume Aama Samuha Museum

Priyanka Shreedar
Sponsor: Nancy Erbstein, Ph.D.
Education

In Macchapucchre Village, Nepal, infrastructure and lifestyles have changed dramatically in recent decades. There is growing local concern that cultural traditions are fading and historical knowledge is being lost, especially amongst youth. In 2010, the local Aama Samuha (Mother's Group) of the Gurung ethnic community constructed a multi-room building, built shelving, and collected cultural artifacts. As of 2019, the museum was still in an early phase of development. The interdisciplinary 2019 Oral History Project Team, comprised of UC Davis and Nepali students, was asked to assist with research activity. Meetings with Aama Samuha revealed that historical documentation and generational gaps were primary concerns. In response, our team collected oral histories about physical artifacts, local festivals, and personal life stories by employing a participatory model in which the needs of the local elders guided the research. Informed by a combination of photo sessions and interviews, we developed a bilingual catalogue of 86 artifacts which facilitated thematic reorganization of the museum shelves. The multimedia documentation of our conversations and creation of a Facebook page improve media outreach and youth engagement. Our documentation provides context and provokes questions for further investigation into Macchapucchre Village's history, culture, and residents' stories.

The Middle East and North Africa in U.S. Media Representations: An Analysis of the Term "Mohammedan" in the New York Times (1900-1909)

Sabrina Shupp
Sponsor: Suad Joseph, Ph.D.
Anthropology

My research is focused on the representation and characterization of the Middle East within the New York Times from 1900-1909. The New York Times is considered to be the leading progressive and liberal newspaper nation-wide. I specifically focused on articles relevant to the term "Mohammedan" through the Proquest Historical Newspaper Database. My research will highlight a window of time from January to April of 1900 because of the extensive relevance of articles at the time. The term was used to describe both the ethnicity and the religious state of individuals and groups of people. I found that the term often associates the Middle East and the "Mohammedan" people as foreign and in need of modifications in order to be seen as socially and culturally acceptable. The term is also associated as being inferior to contrasting people groups and religions. This research coincides with a larger project analyzing 150 years of The New York Times.

The Influence of Reverse Problem Solving on Undergraduates' Success with Stoichiometry Problems

Alexander Shvakel
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry students struggle with interpreting given information in problems and separating relevant information from distractors, causing failures in generating successful solutions. Chemistry educators have implemented different methods such as using solution maps to teach their students how to approach problems and successfully tackle them. However, the effectiveness of problem construction by utilizing given solutions on students' problem-solving achievement has not been studied yet. In this study, a group of chemistry students (N=45) participated in three think-aloud sessions. The group was divided into a control group (N=15) and an experimental group (N=30). During the pre-intervention session, all the students were asked to solve five stoichiometry problems while thinking aloud. After two weeks, the intervention session was conducted in which the experimental group was asked to construct eleven chemistry problems by examining the given detailed solutions. In the post-intervention session, both groups solved slightly modified versions of the pre-intervention questions in order to observe changes in their strategy, knowledge, and accuracy. The goal of this study is to better identify students' struggles with solving chemistry problems, and to examine the effects of problem construction as a potential method to increase students' success with problem solving in chemistry and other subjects.

CRISPR/Cas9 Mediated Changes in CENH3 Leads to Haploid Induction on Outcrossing

Mohamed Hisham Siddeek
Sponsor: Anne Britt, Ph.D.
Plant Biology

True breeding lines are of great value to plant breeders and the classical approach in creating a true breeding line involved backcrossing a plant for 7-8 generations. However, haploid induction through the modification of the CENH3 protein can be used to generate true breeding lines in a single generation. The CENH3 protein is a centromere specific histone 3 variant and is essential for the proper segregation of chromosomes. In this project, 31 EMS-inducible amino acid substitutions in the CENH3 gene were characterized for their ability to complement a knockout for endogenous CENH3 and for its ability to produce haploids when outcrossed to a wild type plant. Double amino acid changes were also characterized for its ability to induce haploids. These changes represent a non-transgenic approach to haploid induction and because the CENH3 gene is highly conserved across plant species, we believe that this technology can be transferred to crop plants as well.

Resculpting Society: Eugenics in Twentieth Century America

Sai Siddhaye
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American Studies

Using visual art to identify the personal and generational trauma that accompanies eugenics in America, this project is an intersection of history, art, and politics that maps the trajectory of local and transnational sterilization abuse across the twentieth century. Records of mental institutions, prisons, and government health and welfare services show vast numbers of sterilizations over the century; under the guise of preventative health, both private and governmental institutions have used sterilization as a means for eradicating poor, nonwhite, and culturally divergent communities. This project uses painting and ceramic sculpture as mediums to illustrate how individual bodies are used as vessels for broader genocidal violence. With this project, I aim to emphasize the danger and inhumanity of treating institutions as vehicles for white supremacy, and attempt to center my reproductive justice and anti-eugenics discourse not on the colonizing systems at play, but around the stories of lived experience that they affect.

Assessing Multidisciplinary Approaches to Disease Determinants: A Systematic Review

Rosaura Sierra
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Human Ecology

The research objective is to evaluate the impediments of disciplinary specific knowledge in the integration of subject specific research methods and discern novel approaches and the latest scientific advances when researching influences of disease. To this end, a systematic review is conducted to better map social determinants of health, health disparities, and environmental justice across two social science disciplines, sociology and psychology, and two biophysical, natural sciences, public health and biology. The review period includes the past ten years of multidisciplinary research that describes how health factors are addressed through subject specific research. Articles reporting on search terms such as “social determinants of health”, “health disparities”, and “environmental factors" are identified using commonly-used general academic databases (i.e., PubMed, Web of Science), and discipline-specific databases (i.e., Sociological Abstracts and PsychInfo). Different disciplines have historically had major differences in methodology in their approach to disease factors. Recent adaptations by these disciplines have shifted towards a more cooperative approach across fields. However, there are noticeable opportunities to address the importance of social factors opposed to biological causes that would lead to greater integration across disciplines. Recommendations include scholars should consider and develop strategies around policies that affect social determinants of health.

Hypocotyl Elongation under Varying Light Qualities in *Helianthus annuus*

Brennan Silva
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Plant Biology

The plant circadian clock regulates many processes related to growth and flowering time. Light signaling pathways reset the core circadian oscillator. Variations in light intensity and quality can make growth phenotypes more evident in clock mutants. In Arabidopsis thaliana, the core circadian clock gene EARLY FLOWERING 3 (ELF3) has been shown to be involved in hypocotyl elongation and shade-avoidance responses. However, the effect of clock-regulating genes has yet to be assessed in domesticated sunflower, Helianthus annuus. We aim to quantify the effect of mutation of a sunflower homolog of Arabidopsis ELF3 on hypocotyl elongation in varying light conditions. Sunflower lines with mutations in homologs of the core Arabidopsis circadian clock were isolated from a mutagenized TILLING population and tested against a wildtype line as a control. The sunflowers were grown in vitro in a growth chamber for ten days under a constant light regiment. Juvenile sunflowers were subject to different red to far-red light ratios in order to mimic varying foliar shade conditions. Our data shows greater hypocotyl elongation in elf3 than in wildtype for most light conditions. Additional lines with mutations in the core circadian regulators LUX ARRHYTHMO (LUX) and LATE ELONGATED HYPOCOTYL (LHY) will also be characterized.

Oral Retellings in Spanish and English: An Exploratory Study with DLLs in Kindergarten

Yenifer Silvestre Delgado
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Education

Recent research on the language and literacy development of Dual Language Learners (DLLs) has used standardized measures to document language skills. However, although research suggests that oral retelling may provide better insights into DLLs' oral comprehension and proficiency than standardized measures, many studies have not examined the oral retelling skills of DLLs in both home language and English. In this exploratory study, we gathered narratives of Spanish-English DLLs who were enrolled in a dual language immersion program. A total of 11 DLL kindergarteners were asked to listen to "Frog Where are You" in English and "Frog Goes to Dinner" in Spanish while looking at the pictures in the book, and asked to retell the story in the respective languages on two separate days. Data was collected at the beginning of the school year and again at the end of the first semester. Narratives were coded for structure and calculated for the total number of words and number of different words. Results show that overall children performed better in English than Spanish on both pre- and post-tests on the oral retellings. Results suggest that more focus on the retention of the Spanish language is needed to maintain the DLLs' home language.

Climate Change Influences Resource Allocation Over Time: Environmental Stress Impacts Tuft Production in California Jewelflowers

Lila Simpson
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Evolution & Ecology

Plants make evolutionary trade-offs throughout their lifetime when allocating resources. Resource allocation and investment depend on abiotic factors such as temperature and precipitation which are impacted by climate change. Some species in the Streptanthus clade of California wildflowers appropriate some resources to produce a purple, sterile "tuft" at the apex of one or more stems. The existence of such tufts (also called color spots, terminal clusters or male-sterile inflorescences) has been noted; however, little is known about their function. To learn where individuals' distribute their resources as well as gain insight into the tufts' possible function, I studied four tufted species in the Streptanthus clade: Streptanthus insignis, Caulanthus inflatus, C. amplexicaulis and C. coulteri. Specifically, I developed a protocol using Fiji to measure the area of each tuft and height of the tallest stem for over 100 herbarium specimens from each species. I merged theses data with data on the number and type of reproductive structures, as well as with data recorded on elevation, precipitation and temperature for the location and year in which each specimen was collected. The relationships between these data elucidates the relative importance of tufts and how this changes when they are under environmental stress.

Disruption of VEGFa gene with CRISPR Genome-Editing as Potential Treatment for Neovascular Age-related Macular Degeneration (nAMD)

Tzu-Ni Sin
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MED: Eye Center

The current clinical treatment for nAMD includes repeated, invasive intravitreal injection of anti-vascular endothelial growth factor (anti-VEGF) into the patients' eyes. To relieve both physical and financial burden, we tested CRISPR genome editing technology to induce permanent disruption of Vegfa gene. Here, we compare the editing efficiency of paired and single guide RNAs (gRNAs) with S. pyogenes Cas9 (SpCas9) endonuclease both in vitro and in vivo. After identifying paired gRNAs that are present in both mouse and human Vegfa gene, the DNA vectors expressing the SpCas9 and its corresponding paired gRNAs were transfected into human HEK293T cells. Next, the vectors were packaged into adeno-associated virus (AAV8) and injected into mouse eyes followed by genomic DNA extraction. Deep sequencing was applied to analyze genomic modification. The results showed that the paired gRNAs generated 95±3% truncation, 0.5±0.84% inversion, and 0.15±0.25% insertion-deletion mutations (indels), while single gRNA resulted in 35±16% indels in HEK293T cells. In mouse retina, paired gRNAs generated 29±11% truncation, 18±9.3% indel mutation, and 1±1.3% AAV insertion compared with 7±6.46% indel mutation in eyes that received single gRNA treatments. In conclusion, paired gRNAs produced higher rates of Vegfa genomic disruption than the single gRNAs in both studies.

Movement of *Fusarium oxysporum* f. sp. lactucae by Equipment

Christine Singh
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Plant Pathology

Fusarium wilt of lettuce is caused by the soil-borne fungal pathogen Fusarium oxysporum f. sp. lactucae (FOL).The pathogen can remain in the soil for long periods of time as chlamydospores, and it can be spread within and across fields through the movement of contaminated soil. The present study seeks to understand the ability of the pathogen to spread through equipment. It will be done by obtaining soil samples from the wheels and blades of a tractor after rototilling an infested field. Soil samples from worker boots after walking across the infested field will be also taken. Soil samples will be dried, sifted, and then plated on a F. oxysporum selective media. Colony forming units will be counted to determine the concentration of FOL in each sample and in the original infested field. The results of this study will help to characterize the risk posed if equipment sanitation methods are not taken in the field.

Living Under Regulation in Kashmir- An Ethnographic Account

Kanwaljit Singh
Sponsor: Timothy Choy, Ph.D.
Science & Technology Studies

The Northern region of Kashmir in India has been under perpetual regulation since the last 30 years or so and recently has been under restrictions which range from communication shutdown, curfews, and use of NLW's. My research will focus on the oral narratives of locals which will put light on the impact of these restrictions especially through the use of NLW's in day to day life of a Kashmiri and how it is perceived in a culture of which it has been a part for a long time. These methods of crowd control through the use of NLW's with other means of restriction have created an atmosphere of regulation where the movement of people or objects, and information, etc. is limited thus impacting the life and development of life in Kashmir. While there have been scholarly works focusing on the psychological and physical impact of restrictions in Kashmir and other regions around the world, there is still a need for a work that focusses on the cultural and social impact of such regulations on the day to day life of people. I aim to bring out various aspects of these restrictions through oral histories by using an ethnographic approach.

Synthetic Genetic Array of mRNA Export Factor, DEAD-box Protein 5

Aniketa Sinha
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Viticulture & Enology

S. cerevisiae DEAD-box protein 5 (Dbp5) is an ATP-dependent RNA helicase with a major role in mRNA export. Apart from its canonical function, Dbp5 has been associated with other gene expression pathways, such as transcription, non-coding RNA export, translation, and DNA damage repair. To dissect the function of Dbp5 in these pathways, a previous alanine scanning mutagenesis screen was carried out with GFP-tagged Dbp5. This screen identified a serine residue at position 162 when mutated to alanine (S162A) results in slower growth at 37°C. In large scale screens, this residue was phosphorylated upon DNA damage induction. To determine Dbp5's role in DNA damage repair and cell fitness, temperature and drug sensitivity assays were carried out with untagged-Dbp5 mutants where residues 156 to 163 were mutated to alanine. This screen failed to identify any residues with functions in temperature sensitivity or DNA damage repair. Consequently, we are further sensitizing our mutant strains by conducting a synthetic genetic array to identify the genetic interactions between S162A-dbp5 and other genes involved in gene expression processes. By utilizing this method, we hope to observe phenotypic differences and gleam some understanding as to the finer mechanisms and genetic interactions of the essential Dbp5 protein.

DNA Double Stranded Break Assay using Terminal Transferase and Biotin-dUTP (TdT-DSB)

Vrishti Sinha
Sponsor: Jacqueline Barlow, Ph.D.
Microbiology & Molec Genetics

DNA is required for development and reproduction for all life. Human cells contain over 3 billion DNA bases where its content and arrangement make every individual unique. However, sunlight, chemical exposure, and cellular processes lead to DNA damage. This has harsh consequences as it can lead to cell death due to mutations and DNA rearrangements. If not repaired, cancer or developmental problems arise. Despite this, there are not many ways to quantitatively measure damage. To address this issue, we have developed a Terminal Transferase based DNA Double-Strand Break Assay (TdT-DSB) using mouse primary B cells. We label broken DNA ends with a Biotin-dUTP nucleotide analog, isolate with streptavidin beads, and perform PCR/qPCR to measure the amount of initially exposed DNA. Using the TdT-DSB assay, we detected high levels of DSBs genome-wide specifically in cells exposed to DNase, and break detection was dependent on the addition of Biotin-dUTP. In preliminary tests, we also detected breaks at the Sμ locus in wildtype, but not AID-deficient cells, our negative control. The AID protein creates DSBs in B cells to make mature antibodies. This fast, quantitative assay has vast potential to measure break frequency at virtually any locus, including sites involved with replication stress.

Visual Representation of UC Davis' Nitrogen Footprint

Zachary Skalak
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Land Air & Water Resources

Nitrogen is an important nutrient found and used throughout human and natural ecosystems. Worldwide, advanced nitrogen fertilizer technologies are estimated to support food production for over 3 billion people while developed economies have seen gains in nitrogen use efficiency by crops. However, excess amounts of reactive nitrogen can lead to declines in global health, biodiversity, and air and drinking quality when it is lost from soil. A nitrogen footprint provides a standardized measure for the amount of reactive nitrogen released by an entity, such as a university. Using ArcGIS Pro, which is a mapping application that allows us to represent numerical data spatially, we created an interactive map of the embodied and local emissions of UC Davis based on the 2018 nitrogen footprint that the UC Davis Office of Sustainability calculated. We focused on emissions from major contributing sectors such as food, utilities, transportation, research, and wastewater, as well as fertilizer and refrigerants. By visualizing the nitrogen emissions data, we hope to help individuals understand the source of nitrogen emissions on campus and assist people in making more sustainable lifestyle choices. Additionally, we hope to help campus decision makers understand the impact of operations and highlight opportunities for reductions.

Exploring the Effects of a Neglected Area: The UN Sustainability Development Goals in Science Learning

Rohan Skariah
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry is often taught an isolated fashion, which is disconnected from the real world, causing students to lose their interest in the subject matter. However, there is actually a great opportunity for educators to spark an interest in their classrooms and contribute to global efforts in achieving UN's Sustainable Development Goals (SDG's). Overcoming complex and multifaceted sustainability issues requires collective efforts of dedicated scientists, economists, politicians, and environmentalists. An earlier study done by our group showed that implementing a learning activity connecting chemistry topics to phosphate sustainability, a socio-scientific issue, has positive effects on both students' motivation and chemistry self-efficacy due to the subject's increased relevancy to students. Based on the positive outcome, the group decided to extend the project to include a larger number of SDGs and connect them to a variety of science topics through the creation of Prezi learning environments. These self-exploratory learning environments will provide students a global vision and an environmental awareness to help them build a healthier future for their communities and the planet. As part of this study, it is also planned to examine the effectiveness of these learning materials on students' understanding of scientific topics, sustainability awareness, and perception of science relevancy.

An Analysis of the Oral Microbiome of Ancient Egyptian Individuals Through Metagenomic DNA Annotation and Sequencing

Ian Slack
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Anthropology

The analysis of microbial DNA extracted from ancient dental calculus has allowed anthropologists to better understand the diets, lifestyles, and disease pathways of ancient peoples. This study examines microbial community data from six individuals from Sai Island, Sudan, and the site of El Hesa, Egypt, along the Nile River, representing Nubian and Egyptian populations from the time of the Roman and Byzantine occupation of modern-day Egypt and northern Sudan. The metagenomic datasets were previously constructed using 150 cycle Illumina MiSeq v3 chemistry kits in the UC Santa Cruz Paleogenomics Laboratory, using standard ancient DNA recovery procedures. In this study, adapter sequences and low quality reads are removed, and the remaining data is annotated for taxonomic classification through database-search alignment software. In our analysis, DNA quality and consistency with the human oral microbiome are assessed and the phylogenetic diversity of annotated sequence data between individuals is compared, with broader implications for dietary and behavioral differences between ancient populations.

Investigation of the Polar Localization of the CKI1 Protein in Female Gametophytes of *Arabidopsis thaliana*

Nicole Slattengren
Sponsor: Debra Skinner, Ph.D.
Plant Biology

In flowering plants, sexual reproduction depends upon the formation of two female gametes: the egg cell and the central cell. These specialized cells are located in the haploid female gametophyte in the ovule of flowering plants. Egg cell identity is associated with the distal pole of the gametophyte, while central cell identity originates from the proximal pole. The CYTOKININ INDEPENDENT 1 (CKI1) gene is required for central cell identity, and encodes a membrane anchored histidine kinase activator of the cytokinin signaling pathway. Expression of this gene results in a protein localized to the proximal domain of the female gametophyte. To learn more about this protein's polar localization and which protein domains are required for proper function, we focused on knocking out sections of the CKI1 gene to determine whether irregular protein localization would result. We hypothesized that protein domains contribute to polar localization. To test this hypothesis, we designed deletions of the CKI1 protein, and determined whether these mutant genes could complement the cki1 mutant. We also replaced the native promoter of the gene with a 35S promoter in order to observe transient expression and localization in tobacco cells. Results from these experiments will be presented.

Creation of an *A. thaliana* Septuple Mutant to Investigate Circadian Clock Control by a Family of Myb-like Transcription Factors

Mitchell Slivinsky
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Plant Biology

Complex transcriptional-translational feedback loops define Arabidopsis thaliana's circadian clock, the network of control mechanisms that time physiological responses to environmental cues. Key transcription factors that participate in these feedback loops include CIRCADIAN CLOCK ASSOCIATED 1 (CCA1), LATE ELONGATED HYPOCOTYL (LHY), and the RVE8 clade proteins including REVEILLE3 (RVE3), REVEILLE4 (RVE4), REVEILLE5 (RVE5), REVEILLE6 (RVE6), and REVEILLE8 (RVE8). Although these transcription factors work together as part of the core clock, they perform antagonistic functions; CCA1 and LHY repress expression of evening clock genes, while RVE8 clade proteins activate expression of these genes. While cca1 lhy mutants have short circadian periods, rve468 mutants have long circadian periods. Interestingly, prior research showed that cca1 lhy rve468 quintuple mutants have wild-type circadian periods at optimal conditions but are less rhythmic at sub-optimal temperatures, indicating that these factors may help the core clock appropriately respond to sub-optimal growth conditions. To further investigate this result, we are using CRISPR/Cas9 to create a cca1 lhy rve34568 septuple mutant. Subsequent analyses on the phenotype of this septuple mutant under a range of light and temperature conditions will be performed to test the hypothesis that these transcription factors improve circadian rhythm robustness in non-ideal conditions.

The Relationship Between Issues of Race and Labor in America from 1830-1892

Kevin Slovinsky
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History

As a study of political thought in the 19th century, this history research project seeks to understand how African Americans saw the relationship between issues of race and labor and whether that relationship changed from the 1830s to the 1880s. If there was a change, how did that affect the ongoing campaign for racial equality in America? The primary sources used are letters, newspaper articles, editorials, and speeches written by African Americans. The research was conducted by using keyword searches on the online archive The Black Abolitionist Papers and a separate online archive of the several newspapers of Timothy T. Fortune. While the research is still in progress, preliminary results show that with abolition and the post-abolition establishment of de facto enslavement, many African Americans began to see the issue of racial equality as being inextricably linked to the interests of labor in its struggle with capital. I hope that this research into America's past reveals a historical relationship between race and labor. Perhaps it will inspire activists to consider the possibility that if inequalities have persisted for an entirety of a nation's history, maybe it is not a defect but a feature of that nation's economic and political organization

Maternal Condition and Offspring Sex Ratios in Centrocercus *urophasianus*

Katherine Smith
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Evolution & Ecology

Many species will invest differentially in male and female offspring by altering either the number of each sex in their broods or the distribution of resources and parental care. The Trivers-Willard hypothesis states that females in lekking polygynous systems will allocate parental investment according to their own characteristics and changes in the environment. Though this physiological mechanism has been studied across taxa, it has yet to be examined in Greater sage-grouse (Centrocercus urophasianus), a species of conservation concern that is used as a model organism for research on lekking systems. I will measure female stress endocrinology, morphometrics, age, and temporal egg laying strategies in order to determine the predictive power that maternal condition and experience may have on male biases in offspring sex ratios. Quantifying this relationship will elucidate the underlying physiology of brood demographics, and through this understanding, the broader implications that anthropogenic stressors may pose on population success.

Effects of Methyl Sulfonyl Methane on Knee Laxity Throughout the Menstrual Cycle

Tayler Smith
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MED: Physiology & Membrane Biol

Anterior cruciate ligament injury in women is associated with high estrogen levels. Estrogen decreases lysyl oxidase activity which prevents collagen crosslinking leading to decreased ligament stiffness. Methyl sulfonyl methane (MSM) is a chemical that forms intramolecular crosslinks, suggesting supplementation could counter estrogen's effect. To test this hypothesis, we recruited healthy women (ages 18-30) for a 5-month period. Months were divided into baseline (months 1&2), MSM loading (month 3) and MSM treatment phases (months 4 & 5). Participants were randomly assigned MSM (3g) or placebo (PLA) in double-blinded manner. Supplements were ingested daily during the loading and intervention phases. Knee laxity was measured using GNRB knee arthrometer (Prothia, Worcester, MA) at menstruation and ovulation. Saliva samples were taken at each measurement for estradiol analysis (Salimetrics, Carlsbad, CA USA). Two-way ANOVA was used to analyze the estrogen and laxity data with significance set at $p < 0.05$. Baseline knee laxity was the same in both groups ($n=14$ for PLA and 11 for MSM). PLA showed a significant decrease in average knee laxity at ovulation compared to MSM group ($p=0.036$). Further investigation is needed to determine whether the rice flour in the placebo actually decreases knee laxity in women.

Investigating Ferroelectric Properties of Rhodium-Doped Strontium Titanate Using Surface Photovoltage Spectroscopy

Nathan Soland
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Chemistry

Nanoparticulate photocatalysts are a promising group of materials capable of splitting water to generate hydrogen fuel, a greener alternative to fossil fuels. Doping well-known compounds with transition metals can be used to improve efficiency, as in the case of rhodium-doped strontium titanate, a strong hydrogen evolution photocatalyst. This experiment investigates the charge transfer properties of $SrTiO_3$:Rh using surface photovoltage spectroscopy (SPS), a contactless technique in which a sample is exposed to light of varying energies and the charge transfer properties are measured with a Kelvin probe. Super-bandgap excitation has been demonstrated as well as increased signal magnitude with repeat illumination, both of which are difficult to explain using traditional band energy diagram models. A ferroelectric model from lattice distortion is proposed as explanation for the behavior, justified with SPS measurements. A novel battery-powered charging technique with and without bandgap illumination is used in an attempt to cause external polarization, studying material tunability. Lastly, the lifetime of induced polarization under vacuum and in air is described.

Effect of Rdh54 on Crossover/Non-Crossover Outcomes During Mitotic Recombination in *Saccharomyces cerevisiae*

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Microbiology & Molec Genetics

Double-strand breaks (DSBs) are among the most lethal types of DNA damage and a source of genome instability that may lead to cancer. Homologous recombination (HR) is a DSB repair pathway that ensures high-fidelity of the repair by copying lost DNA information from an intact, homologous donor. Rdh54 (aka Tid1) is an ATP-dependent DNA translocase well known for its role in yeast meiotic recombination; however, recent evidence suggests it additionally impacts somatic HR in mitotic cells (Piazza et. Al., 2019). The current investigation aims to identify Rdh54's somatic function by examining Rdh54's effect on crossover/non-crossover frequencies. Through utilizing a crossover assay described in Mazon & Symington 2013 Mol. Cell to examine this effect, we can measure two aspects of Rdh54's impact on DSB repair in somatic cells: 1) how much (short vs. long tract conversions) of the homologous donor's DNA is copied during HR, and 2) how often crossover (CO), non-crossover (NCO) or break-induced replication (BIR) pathways are used to complete repair. Current results from comparing wildtype and Rdh54 mutant phenotypes suggest Rdh54 has no significant impact on gene conversion length during HR, and that it does not impact CO, NCO, and BIR frequency.

Identification of Morphologically Similar Insect Pests via CRISPR-Cas12a-dependent Diagnostic

Wenqi Song
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Entomology/Nematology

CRISPR-Cas is a well-known genome editing tool derived from adaptive immunity mechanisms in bacteria and archaea. It has been adapted for many applications in the field of biotechnology, and is widely used in targeted genomic editing applications. In this project, CRISPR-Cas is used to distinguish three species of lepidopteran pests of tomato and potato crops: Tuta absoluta, Phthorimaea operculella, and Keiferia lycopersicella, which share identical external morphological characters in the adult stage. P. operculella and K. lycopersicella are endemic to California, while T. absoluta originates from South America and poses a high risk of invasion into the U.S. Since T. absoluta has been known to cause 100% crop loss, it is critical for growers to be able to identify early invasion of T. absoluta to prevent serious economic damage to the tomato industry. We sequenced the genomes of these three species and observed that although the genomes of these three species share high similarity, there are many species-specific single nucleotide polymorphisms(SNP) sites that can be used for species ID. By designing Cas12a guide RNAs that specifically target Tuta absoluta based on these SNPs and using single strand DNA fluorescent reporters, we successfully differentiated Tuta absoluta from Phthorimaea operculella, and Keiferia lycopersicella.

PEN:PALS (Personal Empowering Narratives: Pilipinx/o/a Anonymous LGBTQIA+ Stories)

Wesley Sosa
Sponsor: William Mead, M.S.
University Extension

Representation can be a very powerful vessel to empower marginalized groups of people, by allowing their stories to be heard and their experiences be validated. Within popular forms of media, there is a growing amount of representation for the LGBTQIA+ community, and the Asian community. However, there is still this gap for those who identify both LGBTQIA+ and Asian. PEN:PALS aims to fill that gap in community and representation, by creating a digital platform centering Queer and Pilipinx narratives. The website will feature user-submitted stories that visualize where the story is submitted from, in order to represent the global presence of Queer Pilipinxs, and the Philippines' migrant population. Marginalized communities that have been overlooked and invisibilized by popular forms of media have their own powerful and impactful stories to tell. These stories carry so much power in inspiring and empowering similarly identified folks, who may be yearning for that representation in stories that they can connect to. These personal stories already exist within people, and PEN:PALS simply creates an inclusive platform for these stories to be finally told.

Spatial Organization of Mitochondrial Inner Membrane Subdomains

Manoushka Sosoian
Sponsor: Jodi Nunnari, Ph.D.
Molecular & Cellular Bio

The mitochondrial inner membrane is an essential platform that conducts and integrates key cellular pathways. The protein-dense inner membrane is highly organized into at least three morphological and compositional domains: cristae, boundary regions, and cristae junctions. Based on localization of a small fraction of the inner membrane proteome, it is thought that respiratory machinery are localized to cristae while solute transporters and protein import machinery are enriched in boundary regions. To test this model and gain insight into the mechanisms underlying the domain sorting of inner membrane proteins, we systematically determined the subdomain localization of a majority of inner membrane-associated proteins in budding yeast. Using high-throughput fluorescence microscopy, we resolved the domain localization of fluorescently-tagged inner membrane proteins by expanding the diameter of mitochondria in vivo. To determine protein subdomain localization, we established scoring categories using pixel distribution analysis of tagged proteins. Our quantification indicates that a majority of GFP-tagged inner membrane proteins localized to cristae, as opposed to boundary regions, and a majority of respiratory and protein import machinery localized to cristae and boundary regions, respectively. Our data suggest a simple model in which boundary and cristae regions are generated by retention of a majority of proteins in cristae.

Essential role of Breast Cancer Susceptibility Gene, *Brca2*, during meiosis

Christopher Soto
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Microbiology & Molec Genetics

Homologous recombination, an error-free mode of DNA repair, plays a crucial role in the maintenance of genomic integrity in both somatic and germ cells. Defective recombination in somatic cells leads to genomic instability, a hallmark of cancer. In germ cells, homologous recombination is essential for proper chromosome pairing, facilitating the reductional division of meiosis. Defective recombination during meiosis is associated with infertility, pregnancy miscarriage, and congenic disease. BRCA2 is a key regulator of recombination in somatic cells, where it mediates the assembly of DNA strand-exchange factor RAD51 onto the ends of broken DNA molecules. While this function of BRCA2 is well characterized in somatic cells, the roles of BRCA2 in meiotic recombination are poorly understood. In this study, we address this knowledge gap. Since BRCA2 is essential for early embryonic development, we utilized a conditional mouse model carrying a flox'd allele of Brca2 exon 11 following excision by the Cre recombinase. Using early and late drivers of Cre expression during meiosis (Stra8-Cre and Spo11-Cre), we show that BRCA2 plays important roles throughout meiotic prophase both as an essential mediator for the assembly of RAD51 and its meiotic ortholog DMC1, and in later steps that ensure the formation of viable gametes.

Topological Statistics in Genome Analysis

Samvardhini Sridharan
Sponsor: Francisco Arsuaga, Ph.D.
Molecular & Cellular Bio

Genomes are highly condensed in all organisms and their three-dimensional organization remains to be determined. Theoretical studies of polymers in confined volumes predict that chromosomes should be highly entangled. Despite the assumption that entanglement inhibits function, the knotting of genomes has proven critical in transcriptional output. In this project, we developed statistical methods to study the interplay between chromosome structure and its topology in Saccharomyces cerevisiae. We employ linking numbers to generate a statistic called the linking proportion (LP) that helps us hypothesize that the RabI configuration reduces topological entanglement of chromosomes. To further test this hypothesis we (1) used statistical methods to test for the stability of LP (2) performed an evolutionary history using phylogenetic software and literature review to follow the evolution of RabI and (3) used a bioinformatic pipeline to analyze Hi-C data to produce 3D reconstructions of a synthetic yeast chromosome. It is our final goal to determine whether these reconstructions are consistent with topological measures as well as evolutionary history.

A Study on the Impact of Increasing Availability of Credit on the Growth of SHGs in Regions Across India

Ranjini Srikantan
Sponsor: Kristin Kiesel, Ph.D.
Ag & Resource Economics

Microfinance provides credit to low income and unemployed individuals who otherwise would not have access to financial services. Self Help Groups (SHGs) are at the heart of making the microfinance program successful. They started as self funding small groups and the number of SHGs in any area was restricted by the ability of these groups to raise money beyond what the groups could fund themselves. The paper explores the availability of credit from Public Sector, Private Sector, Regional Rural and Cooperative Banks on the impact of growth of SHGs across the 29 states and 9 union territories in India. To understand this impact I have used financial data such as credit availability (independent variable) and the number of SHGs (dependent variable) from the National Bank for Agriculture and Rural Development (NABARD) Microfinance Report 2017-2018. Results from my regressions show that the credit available from Public banks have the most impact. The highest beneficiaries are the states across the Eastern regions of India. As the paper explains through quantitative and qualitative analysis, commercial banks have a widespread impact in alleviating the conditions of the poor in rural India.

BioInnovation Group's Algae to Insulin Project: *Chlamydomonas* reinhardtii Chloroplasts as a Sustainable Biomanufacturing Platform

Brian Stallings
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Biomanufacturing plays an ever increasing role in our society, responsible for creating products ranging from therapeutics to industrial chemicals to food products. However, the most popular chassis organisms in synthetic biology require large amounts of sugars, amino acids, and frequently, antibiotics and animal extracts. These inputs carry significant financial and environmental costs. Chlamydomonas reinhardtii is a single-celled eukaryotic algae whose chloroplast has been shown capable of producing therapeutic-grade proteins. C. reinhardtii is capable of photosynthesis, and requires as inputs only trace inorganic salts, a buffer, and a simple nitrogen source. We report our progress towards investigating the environmental sustainability of C. reinhardtii as a protein production platform, and our progress towards genetic construct design and algal strain engineering with mini-proinsulin as our primary candidate protein. As a BioInnovation Group at UC Davis research project, this project is entirely undergraduate run, and represents a new mode of expanding undergraduate co-curricular biotechnology education.

Biodegradable Plastic Production from Food Waste through the Use of Microorganisms

Britton Stark
Sponsor: Ruihong Zhang, Ph.D.
Biological & Ag Engineering

In the current state of Earth, climate change is heavily influenced by the plastic pollution and the greenhouse gasses emitted by organic waste. Petroleum-based plastics have been a staple of the consumer world since their introduction. The primary issues with these petroleum-based plastics are the amount of greenhouse gasses that are produced in the production and the lack of complete degradation. Rather than continuing the usage of this harmful substance, a more eco-friendly option is necessary. Bioplastics are an appropriate alternative to conventional petroleum-based plastics. They are able to completely degrade without introducing any harmful products and can use food waste as a nutrient source. Certain microorganisms produce these bioplastics as byproducts of their digestion process. This allows for the production of bioplastics while also consuming food waste. We have produced a relatively low-cost bioreactor able to convert food waste into the biopolymer Polyhydroxyalkanoate (PHA), which can be manufactured into bioplastics. We have successfully produced PHA material through controlled, small-scale experiments using glucose as the primary nutrient source. Our goal is to produce a complete system with process criteria that can be scaled up to accommodate industrial level PHA production.

Defective Crossover Regulation in *Brca2* Mutant Spermatocytes

Michael Stickels
Sponsor: Neil Hunter, Ph.D.
Microbiology & Molec Genetics

Meiosis is a mode of cell division required for the formation of haploid gamete cells. Accurate chromosome segregation requires that homologous chromosomes become paired and become connected by at least one crossover. Chromosome pairing and crossovers are both mediated by the repair of programmed DNA double-strand breaks in a process called homologous recombination. When more than one crossover occurs, their spacing is regulated by a process called interference that tends to minimize total crossovers. Defects in crossover patterning lead to infertility, pregnancy miscarriage, and congenital disorders. Brca2 (Breast Cancer Associated Gene 2) encodes a tumor suppressor known to mediate essential steps of homologous recombination – assembly of the DNA pairing and strand-exchange protein RAD51 onto the ends of DNA breaks. We sought to investigate the role of BRCA2 in crossover regulation during meiosis. A conditional Cre-lox mouse model was employed to mutate the essential Brca2 gene specifically during meiosis. Crossover patterning was analyzed by immunolabeling surface-spread spermatocyte chromosomes for the crossover-specific marker MLH1. Our analysis revealed that crossover interference is defective in Brca2 mutants, with the observation of closely spaced double crossovers. These surprising observations point to unanticipated roles for BRCA2 in later steps of meiotic recombination.

Exposure of Nurse-Midwifery Students to Breastfeeding Patients During Clinical Rotations—a Mixed Methods Pilot Study

Kathryn Strock
Sponsor: Nicole Polen-Petit, Ph.D.
Human Ecology

Breastfeeding improves maternal and child health. While midwives are the frontline maternal care providers, they receive inadequate training in clinical lactation skills and report feeling a lack of confidence upon graduation. It is not known how much exposure midwifery students have to diverse breastfeeding patients during their training. The primary objective was to quantify and qualify midwifery students' exposure to breastfeeding patients during their required clinical rotations. The secondary objective was to determine their self-efficacy with clinical lactation skills upon graduation. Study participants were 8 midwifery students at the University of Michigan. Data on self-efficacy and patient encounters were collected via questionnaire with close-ended 7-point Likert scale, multiple choice, and open-ended questions. Descriptive statistics were used to calculate the mean and standard deviation. Midwifery students (N=8) reported feeling confident (6.26 out of 7) in 21 clinical lactation skills. Students interacted with breastfeeding patients in the labor and delivery unit during their clinical rotations. Analysis of patient encounters is ongoing.

Contributions of Somatostatin-Expressing Cells to Glycemia

Jodie Stroeve
Sponsor: Mark Huising, Ph.D.
MED: Physiology & Membrane Biol

Over 30 million Americans have diabetes, which occurs when their bodies lose control over blood glucose homeostasis. To effectively combat diabetes, the mechanisms underlying its onset and perpetuation must be clearly understood. Somatostatin, a peptide released by pancreatic delta cells, could play an important role in maintaining proper glycemia, which is disrupted in diabetes. However, somatostatin is also expressed by many other tissues, including the brain, gut, and stomach. I hypothesize that pancreatic delta cells are the main source of somatostatin for controlling glycemia. To test this, we will ablate somatostatin-expressing cells and knock out somatostatin in mice to determine how the absence of somatostatin affects glycemia, beta cell activity, and other body organs' functionality. In particular, we will focus on the potential contributions from somatostatin-expressing cells in the brain, gut, and stomach. We will examine this by imaging collected slices of these organs for somatostatin expression and by performing RNA extractions and qPCR to determine the presence of somatostatin expression in these organs. These results will confirm whether or not our observations of altered glycemia and beta cell activity are results of paracrine feedback mechanisms in the pancreas or systemic mechanisms of the entire body.

Using Passive Eye Tracking to Measure Language Comprehension in Autism

Thitisa Sudayuworn
Sponsor: Susan Rivera, Ph.D.
Psychology

The "Looking while Listening Task" (LLT) is a passive eye-tracking paradigm used to index language comprehension. Participants are shown images depicting two nouns, one of which is named. Given research suggesting differences in motor function and social attention in Autism Spectrum Development (ASD), the LLT's passive approach may have particular value in ASD. The present study investigates the convergent validity of LLT in ASD and Typical Development (TD) through comparison with established language measures, the PPVT-4 and CDI. Data were collected from 28 ASD (mean age = 38.40 months) and 11 TD (mean age = 34.72 months) participants. There were robust positive correlations between LLT visual preference to the named target and PPVT scores, r (15) =.72, p = .001, and between LLT visual preference and parent-reported word knowledge on the CDI, r (25) =.65, p = .0001. However, visual preference did not differ between words known and unknown to ASD individuals per parent-report, t(8) = -0.35, p = 0.74. The convergence between LLT and traditional language assessments supports the validity of LLT, but the lack of convergence with parent reports of knowledge of individual words emphasizes the complexity of the challenges surrounding measurement of language in ASD.

Improving Tomato Fruit Texture by Generating Plants with Double and Triple Knockout/Knockdown of Genes That Encode Cell Wall Modifying Enzymes

Yuko Sugiyama
Sponsor: Barbara Blanco-Ulate, Ph.D.
Plant Sciences

Historically, tomato fruits have a short shelf life, which is unsuitable for the market. Currently, tomatoes have been bred for longer shelf life, but many quality traits, such as taste, are neglected. My project aims to retain fruit quality traits while extending tomato shelf life. One possible approach to prevent fruit deterioration is to reduce the softening rate, which is mainly lead by changes in the cell wall polysaccharide composition and the degradation of pectin caused for the activity of enzymes. This project focuses on evaluating mutant tomato fruits that have knockout/knockdown the expression of genes that encode for these ripening enzymes: polygalacturonase (PG), pectate lyase (PL), and expansin (EXP). By crossing two different mutant plants each carrying a different edited or silenced gene, I am generating double knockdowns/knockouts. Using PCR with specific primers and gel electrophoresis, the genotype of both parent and progeny can be confirmed. In the future, plans to determine the effects of the double mutation on fruit quality and shelf life properties will be obtained and evaluated. This is the first stage for understanding the role and interaction of multiple genes encoding cell wall modifying proteins in the shelf life of tomato fruit.

The Effects of Molt on Innate Immunity in Chickens (*Gallus gallus domesticus*)

Jana Charisse Suico
Sponsor: Kirk Klasing, Ph.D.
Animal Science

For poultry, there are a variety of nutritionally costly life stages that must be balanced with the costs of the immune system. Molt is known to be expensive in terms of nutrient requirements due to metabolic costs associated with producing feathers quickly. Little is known about the relationship between molt and immunity. The objective of this study was to use chickens (Gallus gallus domesticus) to clarify the impacts of molt on nutritional investment in immunity during a challenge to the innate immune system. Four treatment groups (n = 7) were used: 1) No molt 2) No molt + LPS challenge 3) Molt and 4) Molt + LPS challenge. Chickens were shifted from a long-day schedule to a short-day schedule and administered oral thyroxine at a dose of 1.25 mg/kg of body weight. An injection of lipopolysaccharide (LPS) (1.5 mg/kg) was administered three weeks after the onset of molt. Liver, spleen and thymus samples were collected for evaluation of cytokines using qPCR. Molt status was found to significantly affect the size of both the spleen and the thymus ($p < 0.001$). The results of this research can be used to inform subsequent research on management practices that optimize immunity during molt.

Social Relationships in Sorority Family Lines: Analyzing the Big Little Relationship

Madeline Sullivan
Sponsor: William Mccarthy, Ph.D.
Sociology

Sororities have been around since the 1850s. They started off as a safe space for women who had just integrated into co-education colleges. Sororities today still share the same ideals, but new modern ideologies have shaped and changed the norms. When a woman joins a sorority they are placed into a "family line" and given a big sister. This big and little sister relationship is the main relationship focused on in this research study. The research question is, "How are social relationships in sorority family lines created and maintained over time?" 10 interviews were conducted with sorority women who became bigs or littles. The interviews focused on the member's involvement in sorority life and their own family line. Main conclusions showed that each woman created their own idioculture within their family line that either differed or connected with their sororities specific habitus. Each woman also discussed a chapter culture that decided how they behaved in the relationship. This big little relationship was found to be a defining one in a woman's future within her sorority and college career. Further research should be conducted with more interviews over time showing the full extent of the impact of the big little relationship.

Using Laboratory Observation Protocol to Analyze Teaching Practices in Chemistry Laboratories

Muhammad Sulman
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Beginning in Fall 2017, the Chemistry Department at UC Davis started a pilot program through which undergraduate teaching assistants, formally known as Emerging Scholars (ES), have been working with graduate teaching assistants (TA) in laboratory settings. In order to observe and study the differences in student interactions with the TAs and the ESs, every TA and ES was asked to audio record their conversations during two lab sessions. After the audio data were collected, they were first transcribed, and student interactions with the lab instructors were coded using Laboratory Observation Protocol for Undergraduate STEM (LOPUS). The findings of this study will reveal whether students are more comfortable approaching TAs or ESs, and how the teaching styles may vary between the two lab instructors. Student inquiries and TA's or ES's responses will be carefully examined to better understand the instructional styles in the labs. These observations and analyses will reveal the efficacy of the Emerging Scholars program and provide the guidelines to enhance student learning experiences.

Long-run Effects of Famine Experience on Social Attitudes

Xianzheng Sun
Sponsor: Karen Bales, Ph.D.
Psychology

The 1959-1961 famine of China has great salience in history. Some studies have been conducted on its long-run influences on health, yet little about the consequences of the famine on social attitudes have been studied. The aim of this study is to examine long lasting effects of China's 1959-1961 famine on survivors and the successive generations, focusing on their social and political attitudes. To estimate the severity of the famine, we calculate the expected birth number for year 1959-1961, and calculate the deviation from such expectation using 1990 census. Our results show that severity of famine at city level is negatively associated with trust, of residents, towards local media. In contrast, we do not find any effect for trust towards the local government. As a placebo test, we do not find any effect for cohorts born after the famine, which also shows no intergenerational transmission of attitude. This is a preliminary project, and we are still analyzing data for further results.

Effects of Eye and Eyebrow Information on Emotion Recognition

Guoqin Sun
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Despite being the most communicative feature of human beings, emotions are not being applied while designing most of the current Human-Computer Interfaces; This is primarily due to the technical difficulty in accurately recognizing the emotional state of a person. Today, research techniques focus on facial expressions, speech patterns, and gesture movements to make inferences regarding a person's feelings. However, impracticalities of the current methods exist as there are physical and computational limitations to implementing the machine learning models that incorporate emotion recognition based on facial expressions, speech, or gestures. Recent studies show that our eyes and eyebrows dominate most of our communication of emotional states. Therefore, in this research, we propose to approach emotion recognition by training machine learning models only on the images of the eye and eyebrow. We extracted the eye and eyebrow portion of the existing datasets of facial expression images used to train current emotion recognition models, and we investigated the effect of the predictions made by Support Vector Machine, Convolutional Neural Networks, Boosted Decision Trees, and Hidden Markov Models. Our results suggested that this novel approach can be actively applied to conventional products to enhance the interaction of humans with computers based on emotions.

Predictors of Unplanned Readmission and Mortality after Below Knee Amputation

Avni Suri
Sponsor: Mimmie Kwong, M.D.
UCDHS: Department Of (med)

Perioperative mortality and unplanned readmissions are considered quality indicators for patient care. However, published data suggests that major lower extremity amputation is associated with low survival and high complication rates. To study the risk factors for poor outcomes in our patient population, we conducted a retrospective review of all patients who underwent below-knee amputation (BKA) between July 2014 and June 2019 at our medical center. Patient demographics and preoperative conditions were collected and statistical analyses was performed to determine predictors of 30-day mortality and unplanned 30-day readmission. 128 patients (69% male, mean age 62.7) underwent BKA during the study period. There were high rates of medical comorbidities, including diabetes (71%), coronary artery disease (48%), and chronic kidney disease (48%). The overall 30-day mortality rate was 4.8%. 27.3% of patients experienced a complication during the admission. The overall unplanned 30-day readmission rate was 29.8%. Independent predictors of 30-day mortality included coronary artery disease (p=.01), congestive heart failure (p=.008), preoperative clopidogrel use (p=.01), and complications during admission (p = 0.046). The most significant predictor of unplanned 30-day readmission was wound complications (p=.002). Future efforts to reduce readmissions after lower extremity amputation should be aimed toward prevention and outpatient treatment of wound breakdown.

Shoes that Last: a Sustainable Approach to Growing

Vania Sutandi
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Children's bodies grow rapidly during their first few years, which results in high consumption of children's clothing. In particular, children's shoes might only be used a few times before needing to be replaced. It is estimated that children, in general, grow out of their shoe sizes at least 3-4 times a year. This rapid shoe consumption contributes to waste and can also be a financial burden for families with young children. Based on the results from user interviews and secondary research on existing products, we propose to design a children's shoe that can accommodate foot growth across multiple shoe sizes. To do this, we will incorporate a number of recent innovations in functional apparel, such as expandable knits, experimental closures, waterproof finishes, and flexible soles to arrive at a prototype that is comfortable, functional, and long-lasting. With this project, our design can lead to more sustainable products that incorporate innovative materials and construction techniques for transformable wearable design applications.

Improving the Time and Cost-Efficiency of the Tobacco Mosaic Virus ELISA

Papawee Sutthirat
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The enzyme-linked immunosorbent assay (ELISA) has been one of the most widely used plant's pathogen detection methods since its invention in the early 1970s. The method involves using an antibody to immobilize an antigen and a second enzyme-conjugated antibody to detect the virus colorimetrically. Although popular, because it gives the opportunity for quantitative and accurate diagnosis, the ELISA can be a time-consuming assay, often taking lab technicians two days to get a diagnosis. In that time, a virus can quickly spread, potentially ruining a crop destined for seed stock. The aim of this project is to reduce the time and person-hours needed to perform an ELISA for the tobacco mosaic virus (TMV). We are exploring the influence of changes to numerous experimental parameters on the sensitivity, cost, and time associated with the assay. For example, in early experiments, we explored different modes of mixing and sample incubation on the efficiency of the binding between the coating antibodies and the sample. Early results show that incorporating shaking at 125 rpm into the sample incubation step will reduce the amount of time needed to perform an ELISA while maintaining the expected sensitivity of the assay.

Reactive Oxygen Species Induced Alteration of Membrane Lipids

Riley Swift
Sponsor: Helen Raybould, Ph.D.
VM: Anat Physio & Cell Biology

Several metabolic diseases are characterized by an increase in the production of reactive oxygen species (ROS), such as diabetes, Parkinson's disease, and stroke. Many ROS are free radicals, which contain a highly reactive unpaired electron. In healthy individuals, ROS are localized to the mitochondria where they are neutralized by either metabolism or antioxidant activity. An imbalance between the production of ROS and antioxidant activity results in a condition known as oxidative stress. ROS can react with proteins, lipids, and DNA if they are unsuccessfully eliminated from the body. The gap in the knowledge is how the structure and function of membrane lipids are altered by oxidative stress. In order to fill these gaps, I have conducted a pilot study using an assay in order to quantify changes in the concentration of ROS in various tissues. I am also developing a procedure for visualizing oxidative changes in brain lipids using a combination of immunohistochemistry and microscopy. Current finding indicates that supplementation with high fat diet (HFD) for four weeks does not result in significant increases in plasma or liver ROS. Future experiments will either require using a stronger ROS-inducing stimulus, or HFD supplementation for a longer period of time.

Influence of Language Environment on an Infant's Vocabulary

Carolyn Ta
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

When infants learn language, many factors play a role in how quickly they develop their vocabulary. We are studying what influences how many words an infant is able to understand and/or produce. In the lab, parents fill out measures of their child's vocabulary knowledge, language environment, and demographic information. With this data we can see if the number of words an infant knows is related to how many languages or speakers the child hears on a regular basis and other social factors like socioeconomic status. Studies have shown that hearing variation between speakers' voices is linked to easier synthesis of speech structure in infants (Graf Estes, Lew Williams, 2015). In this analysis, we will compile our data from across 15 studies and over 1000 infants. We predict a positive correlation between monolingual infants' vocabulary size and the number of people they hear speak regularly. For bilinguals, we expect a positive correlation between vocabulary size and the number of people who speak their dominant language (the one they are exposed to for the most hours per week).

Generating a Cell Based Assay for High Content Screening of Small Molecules and PROTAC Molecules

Neeki Tahmassebi
Sponsor: Jeremy Chien, Ph.D.
MED: Biochem & Molecular Med

Galectin-1, a ß-galactoside binding protein from the lectin family, is significantly overexpressed in different cancers, such as kidney cancer, ovarian cancer, and breast cancer. High expression of Galectin-1 leads to angiogenesis of tumors, apoptosis of T-cells, cell proliferation of tumors through the RAS pathway, and metastasis of cancer. Identifying novel molecules to target Galectin-1 for cancer therapy is imperative. The intracellular levels of many proteins are regulated by ubiquitin-dependent proteolysis. Our aim is to target these galectins for degradation utilizing a chimeric compound generically termed proteolysis-targeting chimera (PROTAC). To screen for these PROTAC molecules, we developed cell lines overexpressing Galectin-1. Our results indicate exogeneous galectin-1 mCherry fusion protein is expressed at higher levels in HEK293T cells, but lower levels in HeLa cells. The mCherry florescence is heterogenous in HeLa cells, thus requiring additional limited dilution cloning to obtain cell lines with homogenous reporter expression. Galectin-1 mCherry expression and the cell lines we generated may be suitable cell reporter systems to assist in screening for PROTAC molecules for novel therapeutics that target Galectin-1. This screen will enable the identification of novel PROTAC molecules that will result in studies on therapeutic mechanisms using galectin inhibitors as a target for enhanced cancer therapy.

Evolution of Cell Type Number in a *Drosophila* Sex Organ

Yoko Takashima
Sponsor: David Begun, Ph.D.
Evolution & Ecology

Sexual selection within species is a frequent driver of diversification of reproductive traits. In the genus Drosophila (fruit flies), interactions between male seminal fluid proteins and the female reproductive tract are subject to strong sexual selection. Seminal fluid produced by the male accessory gland induces a female post-mating response (PMR) comprised of a set of behavioral and physiological changes linked to male reproductive success. The accessory gland has two types of secretory epithelial cells that are responsible for the production and secretion of seminal fluid proteins: main cell and secondary cells. Main cells are responsible for inducing the majority of the PMR, while secondary cells functions are not well understood, but appear to be involved in regulating remating rates in females. There is a wide range of gland morphology and ratio of secondary cells to main cells, however no studies have quantified these differences. Some species lack secondary cells, while main cells are conserved throughout the genus. Using cellular staining, confocal laser imaging, and 'machine-learning' techniques to identify and count cells in 3D, the purpose of this study is to observe the diversity of secondary cell numbers and to tie differences in mating systems and the PMR across the phylogeny.

Evaluating Expression of Virulence Proteins in Transgenic Lines of Lettuce Inoculated with Downy Mildew

Gizelle Taleno
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

The majority of microbes inhibiting plants are harmless or beneficial to their hosts, yet pathogenic microbes cause diseases resulting in agricultural losses in many crop species. Pathogens can cause disease using proteins called effectors, which are secreted into host cells and promote pathogen virulence. Bremia lactucae is an oomycete pathogen causing downy mildew of lettuce, one of the most valuable crops in the United States. Candidate effectors from downy mildew have been identified and transgenic lettuce plants have been generated that express these proteins. I will use these transgenic plants to assess the ability of downy mildew proteins to promote virulence of downy mildew using a leaf disc assay. Leaf discs will be inoculated with downy mildew and growth will be quantified one week later using quantification of sporulation using an image analysis software and using quantitative PCR to measure the amount of downy mildew DNA in each lettuce leaf disc. Transgenic lines expressing the downy mildew proteins will be compared to transgenic controls expressing green fluorescent protein (GFP). If there is increased growth of downy mildew on a transgenic line compared to GFP, this would indicate the protein expressed is a true effector as it promotes pathogen growth.

Fluorescence Lifetime Imaging (FLIm) for Intraoperative Tumor Detection of Oral Cavity and Oropharyngeal Cancer

Athena Tam
Sponsor: Laura Marcu, Ph.D.
Biomedical Engineering

Oral cavity and oropharyngeal cancer represents 3.0% of all new cancer cases and afflicts approximately 53,000 individuals per year in the United States. The gold-standard for intraoperative diagnosis of these cancers is white-light visualization, tactile feedback, and pathologic consultation via biopsy. However, reliance on these methods are associated with a number of limitations, such as the invasiveness and long procedural waiting times during pathologic consultation. Alternative techniques to improve diagnostic decision-making have been evaluated and reported, with fluorescence lifetime imaging (FLIm) serving as one of the most promising modalities. Using a custom-built, multi-spectral, time-resolved FLIm system to acquire clinical data at the UC Davis Medical Center, we demonstrate the ability to resolve cancer from healthy human tongue and tonsil tissue. We show that FLIm data changes as a function of imaging context (in vivo vs. ex vivo), as well as for intermediate pathological conditions such as dysplasia, thus enabling detection of more specific tissue conditions. Collectively, data acquired from a cohort of 30 oral cavity and oropharyngeal cancer patients demonstrates the potential of this technique for intraoperative implementation for tumor-margin mapping and pathology diagnosis.

Inter-Patient Variability in Response to Antihypertensive Drugs

Allison Tam
Sponsor: Eleonora Grandi, Ph.D.
MED: Pharmacology

Hypertension affects approximately 80 million adults in the United States and is a major risk factor for many common chronic diseases, including heart failure and stroke. Recent studies suggest that visit-to-visit variability in systolic blood pressure is associated with an increased risk of stroke. Among antihypertensive drugs, Ca^{2+}channel blockers (CBs) have been shown to limit within-individual variability in blood pressure, while ß-blockers (ßBs) increase it, and these effects correlate with class differences in effectiveness in preventing stroke in randomized trials. Here, we utilize a mathematical model of the rat mesenteric smooth muscle cell to investigate the largely unexplored mechanisms underlying the changes in visit-to-visit variability by CBs and ßBs. We simulate variability by randomizing model parameters and running repeated simulations. We quantify changes in membrane potential (E_m) and intracellular Ca^{2+}concentration ($[Ca^{2+}]_i$) induced by partial block of the L-type Ca^{2+}current or ß-adrenergic receptors in normal (control) and hypertensive conditions (diseased). Then, we perform multivariable regression to determine the extent by which each model parameter attenuates or exacerbates $E_m$and $[Ca^{2+}]_i$ changes caused by CBs or ßBs. Our analysis provides quantitative insight into the mechanisms underlying within-individual variability and its modulation by antihypertensive agents, thus potentially informing therapeutics.

Wearable Posture Support for Surgeons

Jiaqi Tan
Sponsor: Gozde Goncu Berk, M.A.
Department Of Design

Many medical workers including surgeons develop pain due to standing with poor posture. Lower back, neck and shoulders are the primary body parts affected by muscle fatigue. Our goal is to design a product that supports surgeons' backs while they are performing surgery for hours continuously. We conducted in-depth user research by interviewing eight surgeons about their needs regarding posture and pain during long operations. Our findings show that a potential wearable solution has to be sterilizable, comfortable, and unobtrusive enough to not interfere with surgeons' operations. To meet these constraints, we are developing a wearable product that provides muscular and skeletal support to alleviate pain using innovative materials such as shape memory alloys, polymers, and rapid fabrication techniques such as SLA 3D printing and metal 3D printing. We hope that the product will eventually impact fields beyond medicine, supporting many different individuals with bad posture and back pain.

Assessing Health Disparities in the *Sacramento Hmong Community*: Relationship between Income, Education, and BMI.

Matthew Tan
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

During their settlement in the late 1970s, the Hmong faced extreme incomprehensible changes leading to difficulty adjusting to American society as Secret War refugees from Laos. Since their settlement, the Hmong population has continued to rank low on socioeconomic status, income level, education, and health when compared to other Asian minorities. This study aims to analyze possible health disparities observed in the Sacramento Hmong community by conducting demographic surveys and health vitals. During June-August 2019, surveys and vitals were collected from participants at Hmong cultural events such as age, gender, annual household income, formal education, blood pressure and BMI. Emerging data suggests that income and education level play major factors in level ranges of BMI. Data shows participants with higher income and educational levels had lower BMI ranges ($p=0.05$), suggesting BMI-related inequalities exist among the Hmong population. The Hmong's unique religious and cultural beliefs, distrust in Western medicine, and heavy dependence on government assisted programs are discussed in this study as possible attributes towards the relationship between income, education and BMI found. To reduce socioeconomic inequalities of BMI, inclusive and multifaceted interventions are required to address the observed inequalities, particularly the higher BMI average in certain socioeconomic groups.

Evaluating Neurological Damage in a Juvenile Rat Model of Acute OP Intoxication

Mei-Yun Tang
Sponsor: Pamela Lein, Ph.D.
VM: Molecular Bio Sciences

Acute intoxication with organophosphorus (OP) cholinesterase inhibitors, which include pesticides and nerve agents, can result in seizures that rapidly transition to status epilepticus (SE), convulsions and death. Preclinical research primarily focuses on evaluating OP toxicity in the adult male brain. Therefore, the goal of this study was to study neurological damage in developing male and female animals following acute OP intoxication. Male and female Sprague-Dawley rats (postnatal day 28) were injected with DFP (3.4 mg/kg, s.c) to induce toxicity. Rats were euthanized at 7 d post-DFP for histological analysis. Brains were immunostained for NeuN to identify adult neurons, doublecortin (DCX) to mark immature granule cells, and Ki67 to indicate proliferating cells. Glial fibrillary acidic protein (GFAP) immunoreactivity was used as a biomarker of reactive astrocytes, which is one component of neuroinflammation. DFP males have robustly increased GFAP reactivity, whereas DFP females show moderately increased GFAP reactivity compared to vehicle controls. Positive DCX/Ki67 immunostaining in the males suggests an increase in neurogenesis following DFP, while there was minimal change in these biomarkers in females. The observed sex differences suggest the need to consider sex as a variable when developing therapeutics.

A Novel Human-Machine Interface Using Nonlinear Synchronization

Jessica Tang
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Entrainment is a universal process that leads to temporal synchronization of organisms to an external rhythm. This process can be found in various biological and physical systems such as synchronization of light between fireflies, synchronization of pacemaker cells in the heart, and synchronization of wall clocks. We used this process to improve human-machine interface of medical devices. In this study, we have designed a motor-powered walking stick which can mimic the user's walking rhythm and convert it into automated mechanical acceleration in an attempt to help lift the walking stick. In return, the user would synchronize to the device's movement through entrainment. To model the walking rhythm mathematically, we used the Fitzhugh-Nagumo model, which generates nonlinear sinusoidal oscillations. We tuned the model parameters so that the oscillation frequency becomes close to typical human's walking frequencies. The model was simulated on Arduino, which also controls the sensor and the actuator. The code is written in C/C++. The walking stick was designed using 3D CAD and printed using the stereolithography 3D printer. In our presentation, we will demonstrate synchronization between the walking rhythm and the motion of the walking stick.

NMR Quantification of Halogen-Bonding Ability to Evaluate Catalyst Activity

Yu Ching Tang
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Compared to hydrogen bonding, halogen bonding is a less common and weaker noncovalent interaction between an electrophilic halogen atom and a Lewis base. Most current knowledge on halogen bonding is based on solid-state spectroscopy or computational studies. With the increasing interest in applying halogen-bonding to organic catalyst and materials design, there is a growing importance to develop spectroscopic methods in order to understand this interaction in organic solutions. Here, we demonstrate the first example of quantifying halogen-bonding ability by measuring ^{31}P NMR shifts ($\Delta\delta$) upon binding to triethylphosphine oxide (TEPO). A set of catalytically relevant monodentate and bidentate halogen-bond donor catalysts have been synthesized and the reaction kinetics investigated using a Friedel-Crafts indole addition reaction. Correlation studies between $\Delta\delta(^{31}P)$ and initial rates are conducted. This data will contribute to the knowledge of halogen-bonding catalysis by establishing a systematic method to quantify and estimate the catalytic ability of halogen-bond donating organic molecules.

Using Multicellular Tumor Spheroids to Characterize the Tumor Microenvironment and its Interactions With Hepatitis E Virus Nanoparticles

Kinsey Tarplee
Sponsor: R holland Cheng, Ph.D.
Molecular & Cellular Bio

The poor performance and abundant side effects of many therapeutic drugs are associated with the lack of basic knowledge of the biology and biodistribution of these drugs. For solid tumors, the tumor microenvironment (TME) is one of the factors to dictate the fate of a drug. The TME is made up of fibroblast cells, complex carbohydrates, and cancer-associated over-expression of an extracellular matrix (ECM) in addition to the accumulation of blood vessels surrounding the tumor. Since conventional 2D cell culture fails to simulate the 3D environment of tumors, we used a high throughput technique to develop in vitro multicellular tumor spheroid (MCTS) composed of cancerous and fibroblast cell lines to model some of these TME components. To evaluate payload delivery, distribution, and biological implications of the drug uptake, we utilized fluorescently tagged Hepatitis E viral nanoparticles (HEVNP) functionalized with targeting ligands as a delivery vessel for potential cargo. Furthermore, we employed a multi-model imaging protocol using confocal microscopy, high-pressure freezing, cryo-fixation, and electron microscopy to understand the ultrastructure and distribution of the cellular components of the MCTS and HEVNP within them. Our preliminary results indicate that targeting HEVNP's show increased specificity to cancer cells and some penetrance into the TME.

Pathogen Inactivation During Anaerobic Digestion of Dairy Manure Under Thermophilic and Mesophilic Conditions

Utsav Tatu
Sponsor: Pramod Pandey, Ph.D.
VM: Population Hlth & Reprod

Dairy waste and its treatment is a public safety concern due to the high concentration of dangerous pathogens that it plays host to. Pathogenic activity in dairy manure affects the agriculture industry and the lives of those that live nearby treatment plants and transport lines. Understanding the effects of thermophilic conditions on dairy waste pathogens is a gateway to safer waste management practices. Waste treatment of dairy manure in the United States is primarily done in lagoons, where a majority of the slurry is digested anaerobically by several microorganisms, including pathogens like Salmonella enterica and Escherichia coli. E.coli is a pathogen indicator in manure, so an examination of the change in the number of surviving colonies and the change in concentration of volatile fatty acids (an indicator of metabolic activity) in the substrate under anaerobic conditions at mesophilic and thermophilic temperatures repeated over three time periods could help us better understand the effects of temperature over time for bacterial pathogens in general, which are pervasive in manure waste treatment.

Identifying Students' Motivations and Barriers to Becoming Learning Assistants

Laiba Tauseef
Sponsor: Natalia Caporale, Ph.D.
Neuro Physio & Behavior

Learning Assistants (LAs) have been shown to have positive impacts in undergraduate courses. In addition, recent studies have focused on understanding the impact of being an LA on the LAs themselves, finding increases in science identity and self-efficacy. Given these potential benefits, it is important that all students have the opportunity and are encouraged to become LAs at some point in their college career. At UC Davis, most LAs in STEM courses belong to majority demographics and have high GPAs. The reasons for this lack of diversity is unknown. Furthermore, there is little information about what motivates students to become LAs and what barriers students encounter that prevent them from doing so. This study will explore these questions by surveying and interviewing students who have and have not expressed interest in serving as an LA at UC Davis. The goal is to develop a set of guidelines to promote recruitment of a diverse student population for LA positions, with an emphasis in trying to increase the number of underrepresented students in STEM that participate. This project may be beneficial to LA programs that are trying to increase the amount and diversity of their students.

How to Help Survivors of Violence that are People of Color

Olivia Taylor
Sponsor: Lorena Marquez, Ph.D.
Chicano Studies

The barriers from systematic violence have been impeding restorative justice for survivors of violence, especially people of color who deal with microaggressions daily. African-Americans, including African Diaspora, and Chicanx/Latinx communities struggle with finding resources and professionals with whom they identify and feel safe to share their story. Understanding the multiple challenges is the first step towards healing and ending the cycle of violence in marginalized communities. Communities of color deal with redlining and gentrification, which leaves them with little to no affordable medical care because of low wages and increasing housing rates. In this country, being poor or working class equates to low quality of life and often poor health. Many people of color fear reporting abuse/violence because the communities have historically been silenced by white supremacy, where doctors were ordered to proceed with hysterectomies and vasectomies on men and women of color to lower the population within the community without their consent. Such realities have tarnished trust in healthcare, and set the creadent for continued maltreatment and racism. When we are able to understand the barriers that continuously affect and undermine these communities in its many forms of violence, it will lead to a restorative justice system.

NMR Quantification of Hydrogen-Bond Accepting Ability for Small Organic Molecules

Magda Tellez Chavez
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Hydrogen bonding is a vital aspect of catalysis and many drug-receptor interactions. Current methods to measure H-bonds are time-consuming and costly. We propose a method using ^{19}F and ^{31}P NMR spectroscopy, utilizing commercially available, inexpensive pentafluorobenzoic acid (PFBA) and phenylphosphinic acid (PPA) probes. Over 110 medicinally and catalytically relevant molecules and molecule fragments including heterocycles such as pyridines, quinolines, and benzotetramisoles, were examined with a variety of steric and electronic modifications to elucidate how structure and secondary effects contribute to HBA ability. The HBA abilities of a variety of organocatalysts and metal-chelating amines were also quantified. Hammett plots of meta- and para-substituted pyridines, in addition to para-substituted anilines, demonstrate strong correlation for $\Delta\delta\,^{19}F$ and ^{31}P NMR to Hammett parameters, establishing the ability of PFBA and PPA binding to predict electronic trends. Highly linear behavior between $\Delta\delta\,^{19}F$ and ^{31}PNMR values and proton-transfer basicity, pK_{BH+}, is present, demonstrating that H-bond accepting ability as measured by ^{19}F and ^{31}P NMR is coincident to proton-transfer basicity. ^{19}F and ^{31}P NMR spectroscopy offer rapid and simple tools to quantify HBA abilities, which may contribute to the understanding of H-bonding in the design of novel bioisosteres and organocatalysts for drug discovery and organocatalysis.

Provisioning Behavior in Two Procellariform Seabirds: the Manx Shearwater (*Puffinus puffinus*) and the Leach's Storm-petrel (Oceanodroma leucorhoa)

Riley Temkin
Sponsor: Joshua Hull, Ph.D.
Animal Science

As a group, seabirds have received considerable attention from behavioral ecologists due to their extreme life-history traits. In particular, all species have an extended breeding period during which time breeding pairs provision young while also balancing their own energetic demands. To date, many studies have investigated provisioning behavior in procellariform seabirds. While attention is commonly focused at the intraspecific level of sexually size-dimorphic seabird species, comparatively fewer studies have examined provisioning behavior in monomorphic species and even fewer have explored interspecific differences. We used radio-frequency identification readers to examine provisioning frequency in two closely related species that display distinct foraging patterns, Manx shearwaters (Puffinus puffinus) and Leach's storm-petrels (Oceanodroma leucorhoa). Manx shearwater data were collected on Skomer Island, U.K., while Leach's storm-petrel data were collected on Bon Portage Island, Canada. Although closely related, the Manx shearwater is an order of magnitude larger than the Leach's storm-petrel. I will present comparative analyses of the provisioning behaviors of these two species and evaluate the evolutionary drivers of these differences.

Comparing Neutrophil Spreading on Different Types of Pathogen Surfaces

Lay Heng Teng
Sponsor: Volkmar Heinrich, Ph.D.
Biomedical Engineering

Neutrophils are highly motile white blood cells that engulf pathogens via phagocytosis. In this project, we examine human neutrophil phagocytic spreading on two types of model pathogen surfaces. We coat glass coverslips with different densities of IgG, a molecule produced by the immune system that specifically binds to pathogens, and with lipopolysaccharide (LPS), a major constituent of the outer membrane of gram-negative bacteria. In our experiments, cells are deposited onto regions of a functionalized coverslip and imaged with reflection interference contrast microscopy, which allows us to clearly see regions of cell-substrate contact as dark patches. We analyze recorded image sequences to quantify changes in contact area over time. Our results show that on increasing densities of IgG, the rate of spreading remains constant, but the maximum contact area and the spreading probability increases. This demonstrates that protrusive forces within the cell drive cell movement during phagocytosis, while adhesion affects the probability and extent of cell spreading. Neutrophil spreading on LPS requires the presence of donor serum, which leads to complement activation. Under this condition, cells exhibit similar spreading dynamics to cells on high-density IgG. This exposes the crucial role complement activation plays in the phagocytosis of gram-negative bacteria.

Comparison of Different Alginate-Based Bioinks for the 3D Printing of Patient-Specific Bone Grafts

Alejandro Tenorio
Sponsor: Jonathan Leach, Ph.D.
Biomedical Engineering

The use of biocompatible materials in combination with stem cells and bioactive cues is a promising option for fabricating implants to repair damaged bone. Alginate is an FDA-approved natural polysaccharide commonly used in bioprinting 3D, anatomically accurate, tissue engineered scaffolds. However, little is known of the formulation parameters that dictate the printability and osteogenic response of cells entrapped in alginate. In this study, the printability, biocompatibility, and bone forming potential of four different alginate-based bioinks laden with mesenchymal stromal cells (MSCs) was assessed to create an index of their therapeutic potential. Alginate bioinks produced via addition of thickening reagents exhibited higher print resolution and structural integrity compared to those formed via crosslinking despite similar viscosities among the different bioinks. However, when laden with MSCs, crosslinked alginate improved cell-material interaction and enabled higher calcium deposition when cultured in osteogenic media. Alginate-$CaCl_2$, the bioink most attune to promoting cell viability and ossification, exhibited the largest mesh size, suggesting a positive correlation between the porous microstructure present in crosslinked gels and biocompatibility. To prove the potential clinical translatability of these results, we printed an anatomically accurate scaphoid bone using Alginate-$CaCl_2$ bioink and cultured the implant in vitro to the point of partial ossification.

Analysis of Genome Elimination and Mitosis in Centromere-Based Haploid Inducers of Arabidopsis

Camille Tenyenhuis
Sponsor: Luca Comai, Ph.D.
Plant Biology

The centromere is a specific region on a chromosome and is indispensable for chromosome segregation. In eukaryotes, a conserved centromere-specific histone H3 variant called CENH3 is essential for centromere specification and propagation. In Arabidopsis thaliana, a dicot model plant, crossing strains carrying CENH3 variants with a wild type results in uniparental genome elimination and generates haploid progeny. Haploids play a significant role in accelerating crop breeding. However, the centromere-based system must be better understood in order to utilize it in field crops. The current project aims to characterize optimal growth conditions for efficient haploid induction and cellular features influencing cell division using a range of available CENH3 variants. We will report the effect of variable temperature on growth, reproductive traits, and haploid induction rate using well-characterized haploid inducers. Additionally, we will present the effects of CENH3 variants on mitotic parameters, including centromere size and rate of cell division. The data collected from these experiments will be applied to generate a more efficient haploid induction system.

Designing Novel Actuators that Alter Model Shape and Create a Dynamic System

Ariel Terao
Sponsor: Daisuke Sato, Ph.D.
MED: Pharmacology

Fire ants can work together and form various rafts to float on the water. In this case, each ant is an intelligent element to form active structures and materials. Novel actuators that are capable of altering a model shape is useful for designing dynamic systems. This project is part of a series of projects conducted in Sato Lab. Dynamic systems can be applied to a diverse set of problems like allowing a building to move with the earth during an earthquake so it is less likely to fall or creating an artificial heart that mimics the movement of a real human heart. The goal of this project is to create novel actuators that alter their shape to create part of a dynamic system similar to fire ants working together. This involves C/C++ programming, Arduino, electrical circuitry, and 3D printed structures. The motors are controlled by specifying a set angle of rotation in the C/C++ programming. Each motor controls a 'unit' that can be rotated at different angles to make different 2D/3D shapes. Future development for this project could include using machine learning and artificial intelligence to control the motors without setting a specified angle of rotation.

An Exploration of Anxiety and Threat Bias in Autism

Stacey Tevelev
Sponsor: Susan Rivera, Ph.D.
Psychology

High rates of anxiety and atypical forms of anxiety have been reported among children with Autism Spectrum Development (ASD). In Typical Development (TD), threat-related attention bias has been linked to anxiety. Despite previous research suggesting that the prevalence of anxiety is elevated in autism, there is little research exploring passive measures of threat bias in ASD. In the present study, passive eye-tracking (Tobii X-60) was used to index attention bias towards threatening stimuli (angry faces) in a dot probe paradigm. Preliminary eye-tracking data were collected from 12 TD participants (10 male, mean age = 33.63 months, mean MSEL DQ = 107.35) and 25 ASD participants (22 male, mean age = 37.62 months, mean MSEL DQ = 67.81). ASD children had greater anxiety, as indexed by the Childhood Behavior Checklist (CBCL), than TD children, Welch's $t(19.72) = -3.84$, $p = .001$. However, groups did not differ in threat bias, Welch's $t(21.22) = -0.21$, $p = .84$, and there was no correlation between CBCL anxiety scores and threat bias scores in ASD, $r(17) = .18$, $p = .45$. These results raise further questions regarding the mechanisms responsible for anxiety in ASD and whether these may differ from those in TD.

Antibodies Mediated Depletion of Specific T Cells Population in Animal Model of Primary Biliary Cholangitis

Khanh Thai
Sponsor: Patrick Leung, Ph.D.
MED: Int Med Allergy

Primary Biliary Cholangitis (PBC) is a chronic autoimmune liver disease characterized by the presence of Antimitochondrial Antibodies (AMA) and immune-mediated destruction of small bile ducts. CD8+ KLRG1+ T cells are highly elevated in PBC patients, suggesting their potential as a critical immunological checkpoint. This study aims to examine the potential efficacy of anti-KLRG monoclonal antibodies in depleting KLRG1 expressing lymphocytes and modulating the severity of PBC. Wild-type C57BL/6J mice were chemically induced to develop PBC at 8 weeks of age. At 12 weeks of age, these mice were intraperitoneally administered with anti-KLRG1 antibodies (0.2mg/mouse, 3 times/week). Blood samples were collected bimonthly and mice were sacrificed at 18 weeks of age. Liver and spleen were collected for CD4 and CD8 T cells analysis; liver pathology, AMA and cytokine levels were also examined. Age and sex-matched mice with an isotype antibody control were studied in parallel. Data from a nested of animals have shown a slight decrease in AMA levels in a-KLRG1 treated mice compared to control. Cytokines' immunological changes and liver pathology analysis are in progress.

Rapid NMR Quantification of Hydrogen-Bond Accepting Ability for Small Organic Molecules

Madison Thompson
Sponsor: Annaliese Franz, Ph.D.
Chemistry

Hydrogen bonding is a vital aspect of catalysis and many drug-receptor interactions. Current methods to measure H-bonds are time-consuming and costly. We propose a method using ^{19}F and ^{31}P NMR spectroscopy, utilizing commercially available, inexpensive pentafluorobenzoic acid (PFBA) and phenylphosphinic acid (PPA) probes. Over 110 medicinally and catalytically relevant molecules and molecule fragments including heterocycles such as pyridines, quinolines, and benzotetramisoles, were examined with a variety of steric and electronic modifications to elucidate how structure and secondary effects contribute to HBA ability. The HBA abilities of a variety of organocatalysts and metal-chelating amines were also quantified. Hammett plots of meta- and para-substituted pyridines, in addition to para-substituted anilines, demonstrate strong correlation for $\Delta\delta$ ^{19}F and ^{31}P NMR to Hammett parameters, establishing the ability of PFBA and PPA binding to predict electronic trends. Highly linear behavior between $\Delta\delta$ ^{19}F and ^{31}PNMR values and proton-transfer basicity, pK_{BH+}, is present, demonstrating that H-bond accepting ability as measured by ^{19}F and ^{31}P NMR is coincident to proton-transfer basicity. ^{19}F and ^{31}P NMR spectroscopy offer rapid and simple tools to quantify HBA abilities, which may contribute to the understanding of H-bonding in the design of novel bioisosteres and organocatalysts for drug discovery and organocatalysis.

BioInnovation Group's Algae to Insulin Project: *Chlamydomonas* reinhardtii Chloroplasts as a Sustainable Biomanufacturing Platform

Lauren Ting
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Biomanufacturing plays an ever increasing role in our society, responsible for creating products ranging from therapeutics to industrial chemicals to food products. However, the most popular chassis organisms in synthetic biology require large amounts of sugars, amino acids, and frequently, antibiotics and animal extracts. These inputs carry significant financial and environmental costs. Chlamydomonas reinhardtii is a single-celled eukaryotic algae whose chloroplast has been shown capable of producing therapeutic-grade proteins. C. reinhardtii is capable of photosynthesis, and requires as inputs only trace inorganic salts, a buffer, and a simple nitrogen source. We report our progress towards investigating the environmental sustainability of C. reinhardtii as a protein production platform, and our progress towards genetic construct design and algal strain engineering with mini-proinsulin as our primary candidate protein. As a BioInnovation Group at UC Davis research project, this project is entirely undergraduate run, and represents a new mode of expanding undergraduate co-curricular biotechnology education.

Analysis of Beta-glucosidase B (BglB) Point Mutations for Thermal Stability and Catalytic Efficiency

Thomas To
Sponsor: Justin Siegel, Ph.D.
MED: Biochem & Molecular Med

Employing computational tools to predict enzyme stability and catalytic efficiency is a growing field in protein engineering. To improve the predictive accuracy of enzyme modeling software, a high-quality library of Michaelis-Menten and thermal stability (TM) data are needed for training the algorithms. Previously, we characterized the Michaelis-Menten and thermal stability (T50) constants for 129 variants of ß-glucosidase B from Paenibacillus polymyza . To contribute to the expansion of this dataset, we designed, built and tested three-point mutations: L171G, L171V and L171W. The enzyme variants were modeled with Foldit software, built using Kunkel Mutagenesis methods, and the purified proteins were tested for kinetic activity and TM. This variant set was produced to investigate changes in amino acid size on overall structural stability by mutating non-polar, small amino acids to larger ones. The TM for L171G and L171W indicated destabilization, while L171V remained similar to wild type. Moreover, all mutations showed a decrease in kinetic activity. This suggests the amino acid position: 171 may be catalytically sensitive to changes. The addition of these mutations to the larger dataset contribute to improved understanding of the structure-function relationship of ß-glucosidase B, and aid in improving the accuracy of computational modeling tools for protein design.

Techniques for Inexpensive and Accessible Microfluidic Chip Manufacturing

Ares Torres
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

RNA-sequencing allows for single celled transcriptional profiling. In an effort to make RNA-sequencing more accessible at a low cost, our team built a quick, reliable, and affordable microfluidics droplet controller. The device utilizes chips with engraved channels to direct droplet flow. Droplet microfluidics relies on high resolution channels to produce droplets capable of encapsulating individual cells. To improve the ability of the chips to consistently create droplets, 3-D printing and low-cost photolithography methods were assessed for their ability to create high resolution channels. To validate both the performance of the device and the capability of each fabrication technique, molds for an encapsulation chip were manufactured at various scales, which were then used to create droplets. Chip production methods were assessed on the following criteria: ease of production, manufacturing time, and ability to produce uniform droplets. Our team aims to produce protocols for both methods of microfluidic chip making. Since both methods are less expensive than the traditional chip making procedure, these protocols should provide value to any lab aiming to inexpensively employ microfluidics. When finished, our team hopes that our work will provide greater access to microfluidics and single-celled transcriptomics for researchers both on and off campus.

Understanding the Role a Protein Plays in Chloroplast Stromule Dynamics During Innate Immunity

Alvin Tong
Sponsor: Savithramma Dinesh-Kumar, Ph.D.
Plant Biology

One of the main research areas in the Dinesh-Kumar lab is understanding the role of inter-organellar communication during the plant immune response. Specifically, understanding the role that chloroplast stromules play during the innate immune response in plants. Previously, our lab has shown that chloroplast stromules are induced by a variety of immune signals including H_2O_2, salicylic acid, viruses, and bacterial pathogens. We hypothesize that plants induce chloroplast stromules in response to pathogens and that stromule induction is a positive regulator of the plant immune system. In our current work, we have identified a protein which may be a component that regulates chloroplast stromule biogenesis and function. To understand the role of this protein in immunity, we have identified homozygous Arabidopsis T-DNA insertion knockout mutants. We have transformed these mutants with a chloroplast stroma marker in order to observe stromule formation in planta. We present our data on the characterization of these mutants in response to pathogen infection.

The Relationship Between Binge Eating and Personality Traits

Jeanna Totah
Sponsor: Andrew Yonelinas, Ph.D.
Psychology

Binge eating has been shown to relate to neuroticism, but little is known about whether other personality traits may be associated with binge eating and related eating behaviors as well. To address this question, we examined binge eating and emotional eating behavior in relation to the Big Five personality traits (i.e., conscientiousness, openness, agreeableness, extraversion, and neuroticism). A sample of 277 healthy young adults self-reported their personality traits and eating behaviors using the Ten Item Personality Inventory, the Dutch Eating Behavior Questionnaire, and the Binge Eating Scale. We found that binge eating and emotional eating behavior were related to low openness, low conscientiousness, and high neuroticism. Additional analyses indicated that binge eating was associated with increased restraint in eating, and that restrained eating interacted with neuroticism to further predict increased binge eating. Together, these findings suggest that low conscientiousness and openness—in addition to high neuroticism—are related to binge eating and emotional eating, and that dieting behavior in the presence of high neuroticism is related to a heightened risk of binge eating.

Using Laboratory Observation Protocol to Analyze Teaching Practices in Chemistry Laboratories

Linh Tra
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Beginning in Fall 2017, the Chemistry Department at UC Davis started a pilot program through which undergraduate teaching assistants, formally known as Emerging Scholars (ES), have been working with graduate teaching assistants (TA) in laboratory settings. In order to observe and study the differences in student interactions with the TAs and the ESs, every TA and ES was asked to audio record their conversations during two lab sessions. After the audio data were collected, they were first transcribed, and student interactions with the lab instructors were coded using Laboratory Observation Protocol for Undergraduate STEM (LOPUS). Findings of this study will reveal whether students are more comfortable approaching TAs or ESs, and how the teaching styles may vary between the two lab instructors. Student inquiries and TA's or ES's responses will be carefully examined to better understand the instructional styles in the labs. These observations and analyses will reveal the efficacy of the Emerging Scholars program and provide the guidelines to enhance student learning experiences.

Parent Acculturation and Children's Oral Proficiency: A Study with Head Start DLL Preschoolers

Helen Tran
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Past research has shown that the levels of immigrant parent acculturation (PA) affect their adolescents' academic success and motivation. Research has focused on adolescents from Mexcian-American families. To expand on this topic with younger children and dual language learners (DLLs) from other backgrounds, we recruited DLLs from low-income immigrant families who were enrolled in Head Start centers in Northern California. A total of 27 DLLs from Mexican-American and 81 DLLs from Chinese-American families were assessed on the Picture Vocabulary, Oral Comprehension, and Understanding Directions subtests on the Woodcock-Johnson Tests. PA was collected with the Parent Cultural Social Acculturation, Parent Family Ethnic Socialization Skill, and Parent Ethnic Identity Scales. Results reveal that there were many similarities between the two groups on PA and DLLs' bilingual proficiency. However, Mexican-American parents had higher heritage language identity and heritage language media usage than Chinese-American parents. Correlation results show that parent's self-perceived English proficiency and parental English media usage were correlated with DLLs' English oral proficiency. These results suggest that the PA levels and the bilingual proficiency of Mexican-American and Chinese-American preschoolers are more similar than different and that there may be an association between PA and DLLs' English proficiency.

Exploring the Effects of a Neglected Area: The UN Sustainable Development Goals in Science Education

Emily Tran
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry is often taught an isolated fashion, which is disconnected from the real world, causing students to lose their interest in the subject matter. However, there is actually a great opportunity for educators to spark an interest in their classrooms and contribute to global efforts in achieving UN's Sustainable Development Goals (SDG's). Overcoming complex and multifaceted sustainability issues requires collective efforts of dedicated scientists, economists, politicians, and environmentalists. An earlier study done by our group showed that implementing a learning activity connecting chemistry topics to phosphate sustainability, a socio-scientific issue, has positive effects on both students' motivation and chemistry self-efficacy due to the subject's increased relevancy to students. Based on the positive outcome, the group decided to extend the project to include a larger number of SDGs and connect them to a variety of science topics through the creation of Prezi learning environments. These self-exploratory learning environments will provide students a global vision and an environmental awareness to help them build a healthier future for their communities and the planet. As part of this study, it is also planned to examine the effectiveness of these learning materials on students' understanding of scientific topics, sustainability awareness, and perception of science relevancy.

Using Phylogenetic Footprinting to Identify Regulatory Sequences Involved in Haustorium Development in Orobanchaceae Root Parasitic Plants

Tristan Tran
Sponsor: John Yoder, Ph.D.
Plant Sciences

Orobanchaceae is a family of parasitic plants that parasitize host plants through root interaction. All parasitic plants attach, invade, and acquire resources from the host plant using an organ called a haustorium. We hypothesize these plants evolved the ability to form haustoria through altering the expression of genes present in non-parasitic plants through changes in regulatory elements. Promoter regions important for the regulation of a gene are likely to be conserved across evolutionary time. Therefore, the elements involved in haustorium development and conserved in parasitic Orobanchaceae likely represent changes needed for the evolution of parasitism. To investigate this, I am using phylogenetic footprinting to identify conserved elements in the promoter sequences of several genes that are up-regulated early during haustorium development across multiple species of parasitic Orobanchaceae. I am obtaining the promoter sequences by using polymerase chain reaction with primers in the conserved coding sequences of genes flanking the promoter region. We designed primers using transcriptomic and genomic resources from 6 Orobanchaceae species. Conserved regulatory elements are identified by aligning the promoter sequences. By identifying the regulatory elements involved in haustorium development, we will determine the evolutionary changes needed to originate the haustorium development signal pathway from a non-parasitic plant.

The Development of Molecular Tools for the Study of Endogenous MHCI Protein at Neuronal Synapses

Anthony Tran
Sponsor: Anne Usrey, Ph.D.
MED: Neurology

The proper development of the central nervous system (CNS) requires that appropriate synaptic connections are established. Major histocompatibility complex class I (MHCI) molecules, immune molecules found on the cell surface of all nucleated cells, are expressed in the central nervous system (CNS) throughout development and are required for regulating neuronal synapse formation. It can be difficult to detect specific MHC I proteins with antibodies due to high homology of the many MHCI proteins encoded by the genome. In this study, we design CRISPR-Cas9 constructs to target the locus of H2-D1^{b} (an MHCI gene). These constructs are screened for both on and off target genome cuts by PCR and sequencing after transfection into cultured cells. Further, we design a homology directed repair construct to knock a 3xHA epitope tag to the N-Terminus of H2-Db when combined with our CRISPR-Cas9 guide constructs. This will allow the endogenous expression patterns, levels and physical interactions of H2-Db protein to be assessed by immunostaining, western blot and immunoprecipitation during the early stages of synapse formation, advancing our mechanistic understanding of MHCI protein function in regulating synapse formation.

Exploring the Effects of a Neglected Area: The UN Sustainable Development Goals in Science Education

Emma Tribble
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry is often taught an isolated fashion, which is disconnected from the real world, causing students to lose their interest in the subject matter. However, there is actually a great opportunity for educators to spark an interest in their classrooms and contribute to global efforts in achieving UN's Sustainable Development Goals (SDG's). Overcoming complex and multifaceted sustainability issues requires collective efforts of dedicated scientists, economists, politicians, and environmentalists. An earlier study done by our group showed that implementing a learning activity connecting chemistry topics to phosphate sustainability, a socio-scientific issue, has positive effects on both students' motivation and chemistry self-efficacy due to the subject's increased relevancy to students. Based on the positive outcome, the group decided to extend the project to include a larger number of SDGs and connect them to a variety of science topics through the creation of Prezi learning environments. These self-exploratory learning environments will provide students a global vision and an environmental awareness to help them build a healthier future for their communities and the planet. As part of this study, it is also planned to examine the effectiveness of these learning materials on students' understanding of scientific topics, sustainability awareness, and perception of science relevancy.

DNA Methylation Mediates the Downregulation of mRNAs: A Biomarker for Pancreatic Cancer

Pauline Trinh
Sponsor: Changil Hwang, D.V.M.,Ph.D.
Microbiology & Molec Genetics

Pancreatic Cancer has become the third leading cause of cancer deaths in the United States, with an overall projection in 2020 of 57,600 to be diagnosed and 47,050 to die of the disease. Characterized by its lack of symptoms in the earlier stages and early dissemination, pancreatic ductal adenocarcinoma (PDAC) continues to decimate the population with up to 30% survival at 5 years if localized. Epigenetic alteration is an emerging mechanism in which cancer cells acquire metastatic traits (e.g. enhancer reprogramming, DNA methylation in CpG islands). In this project, we have performed the Reduced Representation Bisulfite Sequencing (RRBS) in the mouse organoid model of PDAC progression. Additionally, as we have identified the hypermethylated CpG islands associated with gene down-regulation, we hypothesize that DNA methylation is functionally responsible for the down-regulation of mRNAs. To this end, we measured mRNA using quantitative RT-PCR upon treatment of the demethylating agent, 5'-azacytidine in metastasis-derived organoids. Identifying select genes which conform to this hypothesized behavior, we commence towards the prospect of developing biomarkers in the novel pancreatic cancer setting.

Generating Molecular Tools to Study the Role of ß2m in the Trafficking and Function of MHCI in Neurons

Christina Trinh
Sponsor: Anne Usrey, Ph.D.
MED: Neurology

In order for the central nervous system (CNS) to develop properly, appropriate synaptic connections need to be established. While major histocompatibility complex class I (MHCI) proteins are known for their role in the immune response, previous research has shown that MHCI also plays a role in regulating neuronal synapse formation. The effects of MHCI on synapse formation require its surface expression, for which the obligate subunit of MHCI, Beta2-microglobulin (ß2m), is necessary. However, it is unknown if endogenous levels of ß2m are sufficient or instead limit overexpressed MHCI function. Here, we design novel genetic constructs to allow the co-overexpression of ß2m and H2-Kb (a MHCI protein variant) at equimolar ratios. These constructs are validated by transfection into Chinese hamster ovary (CHO) cells, and subsequent Western blotting to examine protein levels. The expression pattern of H2-Kb from the co-overexpressing constructs are compared with expression patterns of H2-Kb alone in transfected neurons. These neurons are also examined for changes in excitatory synapse density to determine the functional effect of these constructs. The results of this study will elucidate the role of relative ß2m levels in the trafficking of MHCI in neurons and in synapse formation.

Associations Between PCSK9, Lp(a) Level, and Apo(a) Size Polymorphism in African-Americans and Caucasians

Kevin Truax
Sponsor: Enkhmaa Byambaa, M.D.,Ph.D.
MED: Int Med - Endocrinology

Proprotein convertase subtilisin/kexin type 9 (PCSK9) works by reducing low-density lipoprotein cholesterol (LDL-C) receptor activity causing a less effective removal of LDL-C from the circulation. Lipoprotein(a) [Lp(a)], a type of plasma lipoprotein, contains an LDL-like core wrapped in a unique protein called apolipoprotein(a) [apo(a)], which has high size variability based on genetics. The size of apo(a) is an effective predictor for Lp(a) levels and cardiovascular disease risk. Studies have shown that inhibition of PCSK9 reduces the levels of both LDL-C and Lp(a), resulting in lower risks for atherosclerotic cardiovascular events. However, the mechanism behind this reduction of Lp(a) by PCSK9 inhibitors remains unclear as LDL-C receptors do not play a major role in Lp(a) metabolism. In a cross-sectional study among 327 Caucasians and African-Americans, we determined PCSK9 and Lp(a) levels and apo(a) isoform sizes and assessed their relationships. There were no significant associations between PCSK9 and total plasma Lp(a) levels. However, among African-Americans there was a significant positive association between the levels of PCSK9 and Lp(a) associated specifically with larger apo(a) sizes. These results demonstrate a diverging relationship of PCSK9 with Lp(a) levels associated with defined apo(a) sizes across ethnicity and warrant further investigation.

The Role of Recombination-Associated DNA Synthesis During Meiosis

Travis Tsai
Sponsor: Neil Hunter, Ph.D.
Microbiology & Molec Genetics

Meiosis produces haploid gametes from diploid cells. During meiosis, homologous recombination (HR) promotes chromosome pairing, synapsis, and crossing-over, which are prerequisites for accurate segregation. Errors in HR can cause aneuploidy, resulting in miscarriages and birth defects. Although meiotic HR has been extensively researched, recombination-associated DNA synthesis (RADS) remains poorly understood. RADS is difficult to study in vivo because DNA synthesis enzymes are essential for cell viability, and separating bulk chromosome replication from RADS is challenging. We overcame these obstacles in the yeast, Saccharomyces cerevisiae, by employing the auxin-inducible degron system in synchronized cell cultures to acutely and specifically inactivate RADS. The initial steps of meiotic recombination are required for chromosome pairing and synapsis, but whether downstream RADS contributes to synapsis is unknown. We addressed this using Southern blots to monitor the DNA steps of recombination, and immunofluorescence-cytology to monitor chromosome synapsis. We found that the DNA strand exchange steps of HR are sufficient to promote synapsis without RADS. Moreover, recombination events are already differentiated into those that will become crossovers, indicating this regulation occurs prior to RADS and maturation of recombination intermediates. These studies provide novel insight into the function of RADS and the interplay between recombination and chromosome synapsis.

Optimizing Synthesis of Germanium Nanoparticles and the Effects of Ligand Exchange on Their Electronic Properties

Emily Tseng
Sponsor: Susan Kauzlarich, Ph.D.
Chemistry

Semiconducting nanoparticles are extremely versatile materials with a wide variety of applications. This versatility is attributed to their electronic properties, which can be tuned through the control of size, shape, and surface functionality of nanoparticles. Germanium is a material of interest because of its semiconducting capabilities and its ability to undergo quantum confinement at a size smaller than 24nm, making germanium nanoparticles (Ge NPs) useful for photovoltaic purposes. Using a Schlenk line heating method, oleylamine-capped Ge NPs were synthesized using germanium(II) iodide and germanium(II) chloride dioxane. The resulting samples were analyzed using ICP-MS to determine which precursor resulted in a greater yield of NPs. Varying amounts of Ge precursor were then used to determine how nanoparticle synthesis can be scaled in order to increase efficiency. The electronic properties of the NPs were characterized before and after a ligand exchange using the following ligands: dodecanethiol, sodium sulfide, and iodine.

Development of Low-Cost Photodiode Sun Sensors for CubeSat Attitude Determination

Miyako Tsujikawa
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

Sun sensors are commonly used to orient spacecraft by determining the relative position of the sun. Commercial sun sensors typically cost several thousand dollars, rendering them an implausible option for undergraduate research applications. This presentation discusses the development of sun sensors that use photodiodes as an inexpensive alternative. Preliminary results strongly indicate the viability of using photodiodes as sun sensors for attitude determination in space. A testbed is developed to facilitate testing of the photodiodes in various configurations and characterize their performance and accuracy. The development of low-cost photodiode sun sensors is documented in more detail than existing literature, describing the implementation of mathematical equations into code, circuitry construction, mechanical and experimental design, and fabrication. The resulting sun sensors design will be used for attitude determination on the REALOP CubeSat, the first satellite created by undergraduate students at UC Davis. Additionally, this documentation will be an invaluable resource for undergraduate students across the world who also choose to take a low-cost approach to attitude determination for their own CubeSats.

A Potential Alternative to Castration in Eliminating Boar Taint

Maxine Lien Tu
Sponsor: Trish Berger, Ph.D.
Animal Science

Vasoconstriction in the neonatal pig testes was evaluated as an alternative to castration to eliminate boar taint in pork. This approach was suggested by the reduced lifespan of the corpus luteum following local injection of vasoconstrictors. Epinephrine was injected locally at .01 mg per kg body weight into pig testes on day 1. Testes were collected at 10 days of age from five pairs of treated and control littermates and 16 weeks of age from three pairs of littermates. Testis weights were significantly smaller in treated littermates than in controls. Since the major boar taint compound androstenone originates in the testicular interstitial tissue, the proportion of testicular interstitial tissue was measured in stained tissue sections. The percentage of interstitial space measured with Image J had a tendency to be lower in epinephrine-treated littermates than in the controls at 10 days of age but no significant difference existed at 16 weeks of age.

LARP6 Expression and Type I Collagen Levels in Muscle and Fibroblast Cells

Benjamin Tucker
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Collagen is the most abundant protein in the human body, comprising most of the extracellular matrix (ECM). In skeletal muscle, collagen in the ECM links adjacent muscle fibers and transmits force from the contractile proteins to bones via the tendon; allowing movement. As such, muscular strength is dependent on ECM collagen. Even though collagen plays an essential role in muscle, it is still unclear how collagen content is regulated, or even which cells are responsible for its production. My hypothesis is that fibroblasts within the muscle are responsible for collagen synthesis in part due to their expression of the La Ribonucleoprotein 6 (LARP6). To test this hypothesis, C2C12 muscle and TT-D6 tendon cells were stimulated in vitro and the production of pro-collagen I was determined by western blot. Consistent with my hypothesis, TT-D6 cells increased production of pro-collagen I protein, whereas pro-collagen I protein was undetectable in C2C12 cells. To determine the role of LARP6, a translational regulator of pro-collagen I protein, I will transfect LARP6 into C2C12 cells and measure pro-collagen I levels. If my hypothesis is supported, expression of LARP6 will lead to an increase in pro-collagen I protein in C2C12 cells.

Effect of Resistance Exercise on Muscle Collagen Transcription

Kaelyn Tuermer-Lee
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

Collagen, the main structural component in the extracellular matrix, has been shown to increase in response to resistance exercise. With its critical role in force transfer, collagen is fundamental for maintaining the quality of life in humans as we age. The purpose of this study was to determine by which mechanism our body promotes the transcription of collagen in response to resistance exercise. To achieve this purpose, both tibialis anterior (TA) muscles of five C57Bl/6 mice were electroporated with 3.2kb of the mouse collagen Ia1 promoter driving luciferase. Following electroporation, the right TA muscles of the mice were loaded using electrically stimulated lengthening contractions and collected 18 hours later. Relative luciferase activity in the exercised leg of the mice was ~40% higher than in the non-exercised leg. By contrast, collagen Ia1 mRNA was not different between the legs. These data suggest that the collagenous response to exercise in the mouse is fast. Future work will compare luciferase and mRNA levels at 6 hours.

Iterative Design and Analysis of Standardized CubeSat Structure

Milena Tuimavave
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

REALOP is the first UC Davis undergraduate-based CubeSat team with a launch scheduled for Spring 2021. The structures team is responsible for the design and analysis of the CubeSat frame as well as the integration of control hardware and payload. The goal is to create a structural frame independent of payload, that also provides simple integration of and accessibility to the payload, which uses standardized hardware mounting brackets for ease of mission repeatability. The mounting brackets hold different payload components and control actuators. In order to integrate the electrical PCBs and flight computers safely, a slotted housing unit, referred to as the Stackhouse, will be used to electrically isolate the PCBs from the aluminum frame. To simulate the environment that the CubeSat will experience throughout its lifecycle, research regarding the structure's ability to survive the launch environment and maintain the functional integrity of the CubeSat components will be conducted through analysis of mechanical, thermal, and vibrational loads. A standardized, independent CubeSat structure will allow for simple integration of hardware and scientific payloads for future CubeSat missions.

The Parable of the Passenger Pigeon (*Ectopistes migratorius*): How Colonizers' Words Killed the World's Largest Bird Population

Jenna Turpin
Sponsor: Hillary Cheramie, Ph.D.
University Writing Program

The genre of a species describes the way people communicate about the species. This influences human-wildlife interactions and thus plays a critical role in determining the fate of that species. In the passenger pigeon's (Ectopistes migratorius) prime, it was the most abundant bird species in existence but went extinct. The dynamics of human-wildlife interactions over time defined the progression of the passenger pigeon's recorded history. These interactions varied based on how the dominant people in North America thought about the bird and the genre surrounding its existence. The parable of the passenger pigeon is a poignant example of why genre matters in preserving species and how this can go wrong. Analyzing the historical evolution of the passenger pigeon's genre showed European colonization of North America is what caused the bird's extinction. Conducting a survey of teenagers reflected that the genre surrounding passenger pigeons is itself disappearing. This is an unfortunate result because failing to spread the parable of the passenger pigeon is a threat to every currently endangered species and their respective genres.

The Role of Stress and Parental Support in Children's Executive Function Performance

Jency Umana Linares
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

Executive function is an umbrella term for a group of mental processes necessary to enable thinking, acting and problem-solving. Several studies have indicated that acute stress may have an impact on executive functioning in adults. However, little research has been done to examine the effect of acute stress on executive function in children. The goal of this study will be to examine the impact of acute stress and parental support on executive functioning in children ages 9-10. In this study, a total of 182 participants attended a laboratory visit. Children were randomly assigned to one of three conditions: one where they completed the Trier Social Stress Test for Children and prepared for it alone (high stress condition), one where they prepared with their parent, and a non-stress control condition. Subsequently, children were presented with three different executive function tests measuring working memory, inhibitory control, and cognitive flexibility. We will test the hypothesis that children in the non-stress condition will perform better on the executive function tests compared to children in the high-stress condition. We also predict that children with parental support will perform better on the executive function tests compared to those without parental support.

"The People Want the Fall of the Regimes" – Decolonization and Revolutions in Egypt, 1919, 1952, and 2011.

Saranjit Uppal
Sponsor: Stacy Fahrenthold, Ph.D.
History

The Arab Uprisings of 2011 led to the end of dictatorships, the beginning of civil wars, and ongoing revolutions across the Middle East – but why in Egypt specifically, and why now? The enduring revolution in Egypt takes its place in a long history of protests and demonstrations in a country demanding freedom and independence now for over a century. Looking at British and American government documents, papers, telegrams, newspapers and memoirs since 1882, Western interference and constant intervention contribute heavily to Egypt's multiple revolutions in 1919, 1952, and 2011. Rather than Western media's suggestion of protests in the Middle East occurring as a "spontaneous Spring," historical evidence proves how Britain and the United States purposefully manipulated and controlled Egypt's autonomy for their own economic profits and political benefits. By tying together a cohesive understanding of Egypt's past and present, evidence reflects how the 2011 revolution draws into the longstanding desire for Egyptian freedom from external forces, and their ultimate goal of democracy and independence. By countering modern Western notions of "disruptive" and "sudden" uprisings in temporally backwards societies throughout the Middle East, nations like Egypt can rightfully protest and have their story told truthfully.

Oral Retellings in Spanish and English: An Exploratory Study with DLLs in Kindergarten

Paola Urena Sanchez
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Recent research on the language and literacy development of Dual Language Learners (DLLs) has used standardized measures to document language skills. However, although research suggests that oral retelling may provide better insights into DLLs' oral comprehension and proficiency than standardized measures, many studies have not examined the oral retelling skills of DLLs in both home language and English. In this exploratory study, we gathered narratives of Spanish-English DLLs who were enrolled in a dual language immersion program. A total of 11 DLL kindergarteners were asked to listen to "Frog Where are You" in English and "Frog Goes to Dinner" in Spanish while looking at the pictures in the book, and asked to retell the story in the respective languages on two separate days. Data was collected at the beginning of the school year and again at the end of the first semester. Narratives were coded for structure and calculated for the total number of words and number of different words. Results show that overall children performed better in English than Spanish on both pre- and post-tests on the oral retellings. Results suggest that more focus on the retention of the Spanish language is needed to maintain the DLLs' home language.

A Bacterial Leaf Disc Assay for Evaluating the Ability of Lettuce Downy Mildew Proteins to Cause Suppression of Plant Immunity

Andreina Urrutia Gonzalez
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

The most devastating pathogen of lettuce is Bremia lactucae, which causes lettuce downy mildew. B. lactucae suppresses the plant immune system, increasing the risk for secondary infections by bacteria and other pathogens. In order to see whether pathogenicity proteins of B. lactucae could increase bacterial load in lettuce, we developed an assay using Xanthomonas campestris pv. vitians (Xcv), which causes Bacterial Leaf Spot disease in lettuce. To be able to determine the level of infection in a plant, it is necessary to be able to quantify the amount of bacteria present in a culture of Xcv isolated from diseased tissue. Isolating the pathogen can be difficult without the use of selective media due to excessive growth of other bacteria also present in the sample, so I optimized a selective media for Xcv to enable colony counting from diseased lettuce leaf discs. I will use this assay to quantify bacterial load of transgenic lettuce plants expressing several effectors to assess their ability to suppress the plant's immune system and support secondary infections. These results will help us understand which effectors of B. lactucae target the immune system and understand the basis of secondary infections in lettuce induced by B. lactucae.

Pathogen Inactivation During Anaerobic Digestion of Dairy Manure Under Thermophilic and Mesophilic Conditions

Sri Vaddella
Sponsor: Pramod Pandey, Ph.D.
VM: Population Hlth & Reprod

Dairy waste and its treatment is a public safety concern due to the high concentration of dangerous pathogens that it plays host to. Pathogenic activity in dairy manure affects the agriculture industry and the lives of those that live nearby treatment plants and transport lines. Understanding the effects of thermophilic conditions on dairy waste pathogens is a gateway to safer waste management practices. Waste treatment of dairy manure in the United States is primarily done in lagoons, where a majority of the slurry is digested anaerobically by several microorganisms, including pathogens like salmonella enterica and escherichia coli. E.coli is a pathogen indicator in manure, so an examination of the change in the number of surviving colonies and the change in concentration of volatile fatty acids (an indicator of metabolic activity) in the substrate under anaerobic conditions at mesophilic and thermophilic temperatures repeated over three time periods could help us better understand the effects of temperature over time for bacterial pathogens in general, which are pervasive in manure waste treatment.

The Impact of Nutrient Limitation on the Suppression of Micronuclei Formation by Nucleophagy

Neha Valluri
Sponsor: Kenneth Kaplan, Ph.D.
Molecular & Cellular Bio

Failures to properly resolve sister chromatids during anaphase can lead to an increase in micronuclei, unstable structures containing whole/fragmented chromosomes. Micronuclei are associated with increased genome instability in cancers, and the ability of cancer cells to gain resistance to therapeutic approaches. The wide range of patient outcomes even in similarly graded tumors suggests that exogenous factors might influence cancer progression. Dietary strategies, including fasting, have been suggested to prevent or inhibit cancer progression, however there is little understanding of the cellular pathways that might be involved. Nutrient restriction is known to activate autophagy pathways in cells, a membrane trafficking pathway that targets damaged organelles for degradation in the vacuole/lysosome. We hypothesize that nutrient limitation might activate an autophagy pathway (i.e., nucleophagy) that suppresses micronuclei formation. To test this, we will use budding yeast and mammalian cell-culture. First, we will test the prediction that membrane markers associated with nucleophagy are increased under nutrient limiting conditions. Second, we will test whether nutrient limiting conditions suppress the formation of micronuclei in human cells. Expected results from these experiments and their implications for cancer progression will be discussed.

Investigating Optimal Diets for Laboratory-Reared *Aedes aegypti*

Tess van Schoor
Sponsor: Geoffrey Attardo, Ph.D.
Entomology/Nematology

Aedes aegypti mosquitoes are important vectors of arboviruses including Zika, Dengue Fever, and Chikungunya. Currently, there is no consensus regarding the optimum diet for rearing Aedes aegypti. This study compares five potential diets for rearing Aedes aegypti in a laboratory setting. 1,800 Aedes aegypti larvae from the Rockefeller population were split into five feeding groups. Each group was fed autolyzed Brewer's yeast (AY), a high-protein food source, and/or rice flour (RF), a high-carbohydrate food source. After eclosion, raw data for wingspans, nutritional stores, and masses of adult mosquitoes was collected. The 100% AY group never enclosed. Out of the four remaining dietary groups, the 25% AY and 75% RF diet yielded adult mosquitoes with the longest wings, most lipid stores, and highest weights ($p < 0.05$). Therefore, the 25% AY and 75% RF diet yielded the healthiest adult Aedes aegypti mosquitoes. If laboratories studying mosquito biology begin to implement a 25% AY and 75% Aedes aegypti diet, laboratory-raised Aedes aegypti may be less susceptible to cannibalism and other physical deficiencies--increasing the likelihood that researchers can maintain a stable Aedes aegypti colony.

Investigating the Role of a Disulfide Bond in the pH-Dependent Activity of Thylakoid Lumen Protease

Liam Vance
Sponsor: Steven Theg, Ph.D.
Plant Biology

Chloroplasts are photosynthetic organelles in plants which use light energy, water, and carbon dioxide to produce biomass. Upon absorption of light, an electron transport chain drives pumping of H^+ ions across the thylakoid membrane into the lumen. An important consequence is that the pH of the lumen is acidic or neutral during periods of light or dark, respectively. Certain amino acid residues can gain or lose protons based on the pH of their environment, which can in turn affect the structure and function of a protein. This leads to the question of how pH changes affect the stability of lumen-resident proteins. Cysteine residues can be oxidized to form covalent disulfide bonds, which are important for stability in many proteins. Plsp1 (Plastidic type I signal peptidase 1) is an integral thylakoid membrane protein whose catalytic domain lies within the lumen. A previous study showed that the lack of a disulfide bond in this domain significantly restricted the pH range over which a membrane-bound form of the enzyme is active. Therefore, we hypothesize that the disulfide bond allows Plsp1 to remain active over a broader pH range by enhancing its stability. We plan to use biochemical approaches to begin testing this idea.

Implementation of the Health Belief Model on the *Hmong Population*: Online Health Education on Hypertension

Zoua Vang
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

Cultural and religious beliefs within the Hmong community have caused misunderstandings and mistrust regarding allopathic approaches of medicine. Concepts such as chronic illness, susceptibility, and prevention are often unknown or misunderstood resulting in minimal knowledge of prevalent diseases and low participation in accessible preventative services. This study aims to understand whether online, educational videos using the Health Belief Model are an effective method in improving the Hmong populations' health perception. An online survey was distributed via Qualtrics from January 31st-February 8th. To address linguistic barriers, the survey offered English and Hmong surveys, asking various demographic questions along with a pre-survey and an additional post-survey following an educational hypertension video. Using the 3 point Likert scale, data was computed on a standardized 0-50 point scale. Average differences of pre-and-post survey scores were used to identify effectiveness of educational videos. Analyses reveal a significant increase in health perception of hypertension after exposure to the video (p=.0027). Limitations of the data collected, shortcomings of current methods as well as channels for improvement are also discussed. Results will assist in providing more insight and implementation of effective health educational methods concerning the Hmong population.

Implementation of the Health Belief Model on the *Hmong Population*: Online Health Education on Hypertension

Molly Vang
Sponsor: Christian Bohringer, M.D.
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Examining the Roles of Macrophages and Vascular Inflammation in Broiler White Striping

Oona Vanhatalo
Sponsor: Michael Mienaltowski, D.V.M.,Ph.D.
Animal Science

The rising consumer demand for larger breast muscle in broiler chickens has compromised the quality of the meat, leading to myopathic abnormalities. Chickens in the broiler industry are fed a commercial diet optimized for fast growth. Consequently, the pectoralis major muscle experiences a level of growth that surpasses the efforts of its vascular support, thus leading to increased inflammation, adipogenesis, and likely the presence of foam cells. This combination of events is associated with muscle deterioration and white striping of breast muscle. It is hypothesized that foam cell macrophages contribute to commercial broiler chickens white striping. This study seeks to identify foam cell markers associated with this muscle damage as well as targeted interventions of white striping. One hundred twenty broiler chickens were fed a commercial diet for 42 days; as these birds grew, 20 chickens were culled every 7 days. Necropsies were performed each week on the culled chickens to assign a striping score on the pectoralis major muscle as well as collect samples for downstream RNA sequencing, histology and immunohistochemistry. Images of hematoxylin & eosin and Masson's trichrome stained sections for each chicken were analyzed for detection of muscle damage and macrophage infiltration in the pectoralis major muscle.

In Vitro Analysis of an Alfalfa Variety Genetically Edited for Reduced Lignin

Alexxa Varela
Sponsor: E Depeters, Ph.D.
Animal Science

Lignin, a major structural component in plant cell walls decreases the digestibility of fiber (cellulose and hemicellulose) by ruminants. Reducing digestibility of fiber has a negative effect on livestock production efficiency because the animal obtains less energy from the consumed feed. This research project compares the digestibility of fiber in two varieties of alfalfa, a conventional variety (not genetically modified) and a genetically edited variety for reduced lignin synthesis. These alfalfa varieties were also harvested at two different physiological maturities. The approach to evaluate digestibility uses the following in vitro rumen fermentation methods: (1) gas production syringe system, (2) ANKOM RF Gas Production system, and (3) ANKOM Daisy system. All samples are run in triplicate over three independent runs. Gas methods will provide estimates of rate and extent of fermentation. The Daisy method will measure dry matter and neutral detergent fiber degradation. With the research still in progress, initial findings show that reduced lignin alfalfa at both maturities was higher in digestibility and had a greater amount of gas produced. The goal from this study is to improve our understanding of how lignin impacts the ability of rumen microorganisms to ferment fiber and provide energy to the ruminant productive purposes.

Deconstruction of the Admission Process in Higher Education: a Holistic Examination from a Hispanic Serving Institution (HSI) Perspective

David Vargas Ezquivel
Sponsor: Natalia Deeb Sossa, Ph.D.
Chicano Studies

A holistic review admission process may increase equitable access for Latinx students as well as their degree completion rate. Currently, the Latinx community still has the lowest proportion of college and graduate degree earners in California. According to the Campaign for College Opportunity, “more than 15 million (40%) of California’s population is Latinx” (2018). Thus, the success of the Latinx community is critical, since it is the biggest ethnic group in the state. This data is significant both statewide and nationally since the academic success of the Latinx population directly affects the socio-economic future of those students. I seek to address and examine this educational discourse within institutional spaces as a way to intervene in the success of students, based on a complete comprehensive individual holistic evaluation. My study will be developed through the examination of documents and publications by institutions that have implemented a holistic review process. Equitable access might lead to higher education rates, free of standardized admissions. The validity of this approach will be based on who can contribute to the academic community in meaningful ways, going beyond the reliance on standardized exams and other requirements.

Effect of Roast and Particle Size on Aqueous and Enzyme-Assisted Extractions of Ground Almonds

Emily Vargas
Sponsor: Juliana Leite NobregaDeMouraBell, Ph.D.
Food Science & Technology

The use of plant proteins in the food industry is becoming increasingly popular, especially due to a higher demand for plant-based foods and beverages. Almond milk is a well-known substitute for bovine milk but is not as rich in protein (3.4% vs. 0.5%). An alternative processing strategy to solving this issue is to make the use of aqueous (AEP) and enzyme-assisted aqueous extraction process (EAEP) to increase the protein content of almond milk. This strategy enables the production of milk with higher protein content without the use of hazardous and flammable solvents like hexane. The objective of this study is to determine the effects of roasting and particle size on the AEP and EAEP of almonds. The almonds were prepared under various roasting conditions (unroasted, light roasted, and dark roasted) and ground to different particle sizes (flour, butter, and paste). Extraction conditions were performed using a 1:10 solids-to-liquids ratio, pH 9.0, at 50°C. For the EAEP, 0.5% of alkaline proteases were added during the extraction. Finer grounds were found to increase protein extractability overall, whereas roasting impacted extraction negatively in AEP and positively in EAEP.

Bioprinting Transgenic Plant Cells for Production of Recombinant Butyrylcholinesterase, a Bioscavenger

Anika Varma
Sponsor: Karen Mcdonald, Ph.D.
Chemical Engineering

Plant cells provide a novel system for the manufacture of therapeutics, like butyrylcholinesterase, that can serve as chemical and biological countermeasures against organophosphate nerve agents. We investigate the feasibility of formulating transgenic plant cells into a 3D printable bioink that provides mechanical support, retains viable cells within a matrix, allows sufficient mass transport of nutrients, and, ultimately, increases production and aids in isolation of target products. The first objective of this project is to show biocompatibility of rice cells with bioink components and with the UV curing process. This is done through the use of an absorbance-based triphenyl tetrazolium chloride viability assay along with investigation of a dual-fluorescence-based staining assay. The second goal is to determine the productivity of the bioprinted cells by measuring the expression of recombinant butyrylcholinesterase. This is achieved by means of an assay that measures the activity of the butyrylcholinesterase. Once the viability and productivity of the plant cells has been established, bioprinting of the cells in various geometries, with modified cell densities can be accomplished. This is just the beginning of the design and optimization of 3D printed plant cell bioreactors that may allow continuous perfusion operation and recombinant protein production.

Single Axis Rotation Testing to Determine Camera Performance Thresholds for UC Davis' CubeSat Mission.

Aashay Vartak
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

A critical component to the success of UC Davis' REALOP CubeSat mission is the ability to remotely take clear images of the Earth while in orbit. The goal of this study is to design a controlled testing setup which emulates an orbiting CubeSat to help establish a rotational threshold for which pictures taken by the CubeSat's onboard camera are of acceptable quality for the mission's requirements. An air bearing table is used to produce a low friction, freely rotating surface for testing the Raspberry Pi V2 Camera Module. Experimental parameters for the camera include the picture resolution and the lighting environment. Successful demonstration of the air bearing table for free rotation testing not only determines the requirements for the CubeSat's ADCS (Attitude Determination and Control System), but also serves as a basis to quantify the performance of other components such as reaction wheels and sun sensors to satisfy the mission's requirements. Characterization of the camera will also support its use in missions outside REALOP and in other low budget university satellite missions.

Taking X-Rays of Students' Knowledge Structures with More Advanced Instruments: An Examination of Chemistry Students' Concept Maps

Efrain Vasquez Santos
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

General chemistry is a fundamental course essential for developing a deeper understanding of topics presented in other science courses. To develop more effective teaching methods, it is imperative to find empirical and pragmatic methods chemistry educators can employ to analyze and evaluate how students learn chemistry. Concept maps are commonly used to provide educators a visual representation of students' level of understanding, help students make connections between topics, and measure changes in their understanding after any intervention. Current qualitative and quantitative methods introduce a level of difficulty in analyzing concept maps and determining an objective depiction of a large group of students' conceptualizations. In this study, concept maps generated by students at the end of the CHE 2 series were analyzed under the light of three factors: chemistry performance, math proficiency, and gender. The main goal of this study was to examine the feasibility of using Fiji Image J, a software commonly used in biology, to generate concept maps representative of large groups of students in any field and provide educators a novel synthesis of the use of R Studio and Gephi in examining students' understanding of chemistry topics in connection with gender, chemistry performance, and math proficiency.

Investigating Web Shear Development in Post-Tensioned Box Girders

Emmanuel Vazquez
Sponsor: Sashi Kunnath, Ph.D.
Civil & Environmental Engr

Design of post-tensioned (PT) box-girder bridges is governed by the national AASHTO LRFD Bridge Design Specifications which requires a reduction of the effective girder width to calculate nominal shear resistance. Caltrans amended this provision allowing the full girder width be used assuming the conservatism in the code-based estimation of concrete shear resistance accommodates this concern of reduced shear strength in the presence of ducts. The AASHTO provisions recognize that PT-ducts alter the shear-flow in box-girders; however, no full-scale tests on PT-girders have been conducted in the United States. This research project investigates the development of shear-flow and the resistance provided by concrete, in the presence of a PT-duct, by testing two full-scale box-girder specimens. The 32'-long simply-supported specimens, will be loaded on the bottom flange to simulate the negative moment region adjacent to the column-support of a continuous bridge. The specimen is designed with an 8.5' by 5' critical-section where loading will expectedly result in shear failure, characterized by diagonal cracking in the web. Findings from the testing will verify if the shear resistance of the girder is adequate to meet AASHTO requirements without having to account for a reduced effective girder width.

The Effects of BPC 157 on Ligaments Healing

Kasi Velasco
Sponsor: Keith Baar, Ph.D.
MED: Physiology & Membrane Biol

BPC 157 is a synthetic peptide consisting of 15 amino acids derived from gastric juices of the stomach. Previous studies on BPC 157 have suggested that it participates in musculoskeletal healing. In rats, BPC 157 enhanced the healing of an injured Achilles tendon. This has led to the use of BPC 157 to fight tendinopathy, with people injecting the peptide into their own injured tendons. I therefore hypothesized that BPC 157 would increase the maximum tensile strength and collagen content of engineered human anterior cruciate ligaments (ACL). To test this hypothesis, increasing amounts of BPC 157 were added to the media of engineered human ACL for 6 days and the ligaments mechanically tested without preconditioning. The ultimate tensile stress between the controls and the BPC 157 treated groups were not significantly different. These data do not support my hypothesis. Therefore, BPC 157 does not improve ligament function and likely has a limited effect on human tendons and ligaments in vivo.

South Sacramento and East Oakland: Traditional Latin American Medicine and Healing Practices by Latinx Communities

Monica Velazquez
Sponsor: Susy Zepeda, Ph.D.
Chicano Studies

Traditional medicine in Latin America is the usage of natural substances, a variation of herbs and ointments, for the purpose of healing. My study focuses on traditional medicinal practices in the United States. Specifically, I look at traditional healers known as curanderos in South Sacramento and East Oakland. The purpose of this study is to identify the healing methods used by curanderos for their patients. Traditional healing is used most by Latinx migrants or Latinx of low socioeconomic status. In California 26% of the Latinx population has medical insurance despite federal law requiring enrollment in a healthcare plan. Due to legal status or unaffordability not all Latinx have medical coverage thus using traditional medicine as a primary source. This study looks at Bolivia's healthcare system with the possibility of merging western and traditional Latinx medicine in California. Bolivian policy mandates traditional healing practices be respected and acknowledged when patients visit medical offices and/or curanderos. Via a collection of interviews with curanderos from South Sacramento and East Oakland they give personal insight of what makes and keeps natural traditional Latin American medicine alive.

***Pavítram Apavítram*: Understanding the Female Condition**

Sahiti Vemula
Sponsor: Nicole Ranganath, Ph.D.
Middle East/South Asia Program

Dictated by oscillating levels of gonadotropins and sex hormones, the menstrual-cycle is a typically 28-day process in the female body that prepares the womb for genesis of new life. This process includes the natural phenomenon of menstrual bleeding, which has been constructed as a polluting, shameful process in the bodies of South Asian women. Due to misogynistic notions in the community rooted in religion, an obsession with the physical and metaphysical dichotomy of purity vs. pollution, long-standing gender injustice, and social taboos in South Asia, women face particular challenges in maintaining their menstruation with ease and dignity. The first part of this project reviews current literature on the topic of menstrual hygiene management (MHM), including papers from: biomedical research, anthropological studies, public health studies, advocacy efforts, etc. The rest of this project relates these issues stemming from the subcontinent to local advocacy by exploring how women in the South Asian-American diaspora have continued — or discontinued — to embody the notions of purity and pollution. In trying to understand how these women approach their reproductive health, I take the position of a storyteller, listening to the narratives of these women and advocating for their feminine health and dignity.

Memory of a Salient Distractor is Reduced Following Attentional Suppression During Visual Search

Aditi Venkatesh
Sponsor: Joy Geng, Ph.D.
Psychology

Past research in visual cognition and attention has shown that a salient distractor (e.g., a uniquely colored item) captures attention. Recent studies have shown that suppression of salient distractors can be learned through frequent exposure. However, little is known about how attentional suppression affects the subsequent memory of the salient distractor. We predicted that the precision of the salient distractor in memory would be inversely related to the strength of learned suppression. We tested this hypothesis by asking subjects to perform a visual search task with frequent or infrequent salient distractors. Memory for the salient distractor was probed at different timepoints during a visual search task in order to capture the effect of learning over time. The memory probe included questions regarding their confidence level of having seen a distractor, and the color and location of the distractor. Consistent with our hypotheses, the results indicated that memory for the frequent salient distractors degraded over time as suppression improved on the visual search task; however, memory for the low frequency salient distractors was highly precise. To conclude, attentional suppression of salient distractors leads to a reduction in precision of memory for that distractor, suggesting that attention gates memory.

RXR Agonists Potentiate Thyroid Hormone Action in the Lower Jaw of *Xenopus* Tadpoles

Lara Vetter
Sponsor: John Furlow, Ph.D.
Neuro Physio & Behavior

Thyroid hormone (TH) is essential for development, including the regulation of skeletal and cartilage growth. Distrupted TH signaling can lead to adverse biological outcomes. Thyroid hormone receptors (TRs) heterodimerize with Retinoid X receptors (RXRs) to regulate genes, but RXR ligands do not appear to affect TH signaling in adult tissues. Amphibian metamorphosis, especially in Xenopus laevis, the African clawed frog, is a well-established in vivo model for studying the developmental actions of TH. In certain tissues, we have shown that RXR ligands affect TH signaling using a metamorphosis assay. The lower jaw undergoes dramatic TH-mediated remodeling during metamorphosis to support new feeding and breathing styles, yet there is little known about the mechanism that underlies these changes, or the influence of RXR ligands. We measured the effect of RXR ligands on TH signaling in the jaw through quantitative morphology, differential gene expression and cell proliferation. Both pharmacologic (bexarotene) and environmental RXR agonists (tributyltin) potentiated TH induced responses but were inactive in the absence of TH. Further, an RXR antagonist, UVI-3003, inhibited TH action. These studies provide increased understanding about modes of TH action in an important target tissue, including the ability of RXR ligands to enhance or inhibit TH signaling.

Influence of Extreme Environmental Conditions on Survival of Two Lineages of Brown Dog Tick

Paola Vidal
Sponsor: Janet Foley, D.V.M.,Ph.D.
VM: Medicine & Epidemiology

Rhipicephalus sanguineus, the brown dog tick, has a worldwide distribution and is a vector for diseases of people and other animals, including potentially fatal Rocky Mountain spotted fever (RMSF). Multiple RMSF outbreaks have occurred recently in northern Mexico and Arizona. Recently, it has been described the brown dog tick is not truly a single species but rather comprises a species complex with a distinct tropical lineage and temperate lineage. These lineages were thought to be limited geographically by climatic conditions but the tropical lineage is now extending its range northward. The aim of this study is to compare survival between these lineages under extreme environmental conditions. We will be looking at how long these tick lineages will be able to survive at low humidity (15%) and moderate humidity (75%) at temperatures ranging from -5 °C to 45 °C. Conclusions from this study will allow us to understand what factors might influence how ticks might spread, and will help predict how different lineages of the species might spread disease in the future.

Effects of Ultraviolet Aging on the Mechanical Properties of Polylactic Acid

Angani Vigneswaran
Sponsor: Sarah Miller, Ph.D.
Civil & Environmental Engr

Polylactic acid (PLA), a bio-derived thermoplastic, has potential to be a more sustainable alternative to common structural materials. This study investigated changes in the mechanical properties of PLA specimens that were exposed to UV light. The PLA specimens were prepared according to the ASTM D790 standard. They were injection molded and aged under UV light for either one day, three days, seven days, or fourteen days. After the specified time intervals, three-point bending flexural tests were conducted on the specimens, with the aged side in tension. Results from the flexural tests show no change in flexural modulus. There is an increase in flexural strength and toughness from one to three days, but a decline in both properties afterwards. The initial increase in strength and toughness may be due to recrystallization within the PLA. After the three-day mark, the polymers in the PLA may begin to break, resulting in their degradation. The results of this study show that PLA may be a promising eco-friendly alternative to existing materials, but more studies need to be done to better understand PLA and ensure it is a reliable option.

Testing Efficacy of 12O – a Self-deliverable Autophagy Inhibitor – as a Novel Pancreatic Cancer Treatment

Deepak Vijay
Sponsor: Yuanpei Li, Ph.D.
MED: Biochem & Molecular Med

Pancreatic cancer is one of the deadliest forms of cancer, with a 9% 5-year survival rate, and the incidence rates are only rising. It is becoming increasingly important to develop an effective treatment for this devastating diagnosis. As the growth of pancreatic cancer cells are dependent on autophagy, inhibiting autophagy has become a popular method of treatment. Current autophagy inhibitors are limited by their low efficiency and poor delivery in vivo. In this work, based on the molecular self-assembling mechanism and drug hybridization strategy, we have designed a self-deliverable autophagy inhibitor, 12O nanoparticle, that can both act as an active pharmaceutical ingredient and form a nanoparticle via self-assembly. This nano-drug effectively decreased pancreatic cancer cell proliferation in vitro across several pancreatic tumor cell lines. Immunohistochemical analysis shows that Ki67 expression, involved in cell replication, significantly decreased with 12O treatment in mice compared to the current most potent compound, demonstrating inhibition of cancer cell proliferation. In vivo experimental results also suggested that the pancreatic model for 12O may prove to be a promising pancreatic cancer treatment. Furthermore, this drug opens the door to more treatment possibilities, such as loading other drugs within the 12O nanoparticle for a powerful cocktail application.

LGM2605 Treatment Increases Antioxidant Gene Expression in A549 Cells

Vivian Vo
Sponsor: Angela Linderholm, Ph.D.
MED: Int Med Pulmonary (sac)

Ozone (O3) inhalation has been shown to elevate oxidation of biomolecules in the respiratory tract, worsening pulmonary function. Current treatment involves inhaled corticosteroids which can elicit insensitivity and glucocorticosteroid resistance in asthmatics, prompting consideration of novel treatments. Previous experiments have shown that LGM2605, an antioxidant lignan derived from flaxseed, can aid in attenuating the O3-induced inflammatory process. The objective of this study is to assess the effects of different treatments and see whether LGM2605 can act as a steroid-sparing adjuvant. To replicate the lung model, we utilized type II pulmonary epithelial cells (A549). These cells were subjected to oxidative stress using 0.05 mM tert-butyl hydroperoxide (THBP) for 2 hours, and then treated with varying amounts of either Dexamethasone (corticosteroid) or LGM2605 over a period of 24 hours. Cells were subsequently harvested for RNA extraction and qPCR was used to measure the expression of SOD1, SOD2, NQO2, and Eotaxin 2. The preliminary results suggest that LGM2605 treatment may increase antioxidant genes in these type II pulmonary epithelial cells (A549).

Qualitative Exploration of Amenity-Led Economic Growth, In-Migration and Modernization in the Northern California Mountain County of Lake

Rva Volzer
Sponsor: Clare Cannon, Ph.D.
Human Ecology

This case study looks to develop an in-depth understanding of the political and cultural divisions creating a distinct economic geography in Lake County, CA. Economic growth is critical for addressing poverty and rebuilding after climate change induced wildfires and historical environmental degradation that has severely impacted the area's natural capital. A critical theory perspective, grounded in Community Development, was used as a lens to analyze interviews with residents, policy and research reports, focus groups, and observational field study. In redefining rural communities using dominant economic strategies and updating the definition of "in-migrant," we describe the local political ecology of rural population change given historical and on-going amenity development and a changing political economy. Modernization theory was used to interpret the "culture clash" between in-migrants and the intergenerational locals. It was found that strong regional sub-cultures have led to differing visions of economic development. A pro-growth libertarian alliance focused on tourism dominates county politics while evolutionary growth retaining local values and land-uses is preferred by others. A universal desire to use amenity development as a solution to the county's poverty complicates the dominant narrative of insiders versus outsiders in the literature of mountainous Northern California in-migration led sustainable land-use policy changes.

The Effects of Temperature on Haploid Induction Rate

Rutu Vyas
Sponsor: Luca Comai, Ph.D.
Plant Biology

A common challenge in plant breeding is the time (8-10 years for major crops) it takes to breed valuable traits into crop varieties from wild relatives through genetic crossing and backcrossing. One solution to shorten new variety development time is haploid induction, a process that generates plants with a single (i.e. haploid) genome instead of the two parental ones. I investigated the effects of temperature on S. tuberosum haploid induction rate in an F_2 population that segregates for a haploid induction gene. Using R statistical software, I tested for a correlation between haploid induction rate and the highest temperature recorded the day the crosses were made. I also carried out an unpaired T-test to determine if the classification of an individual F_2 plant as a haploid or non-haploid inducer was affected by the maximum daily temperature when the crosses were made. My results suggest that there is no significant temperature effect on haploid induction rate in the F_2 population. I am expanding this study to search for factors that may be associated with haploid induction rate in potatoes, such as if haploid induction rate is correlated with the number of dead seeds per cross.

Taking X-Rays of Students' Knowledge Structures with More Advanced Instruments: An Examination of Chemistry Students' Concept Maps

Anish Wadhwa
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

General chemistry is a fundamental course essential for developing a deeper understanding of topics presented in other science courses. To develop more effective teaching methods, it is imperative to find empirical and pragmatic methods chemistry educators can employ to analyze and evaluate how students learn chemistry. Concept maps are commonly used to provide educators a visual representation of students' level of understanding, help students make connections between topics, and measure changes in their understanding after any intervention. Current qualitative and quantitative methods introduce a level of difficulty in analyzing concept maps and demanding an objective depiction of a large group of students' conceptualizations. In this study, concept maps generated by students at the end of the CHE 2 series were analyzed under the light of three factors: chemistry performance, math proficiency, and gender. The main goal of this study was to examine the feasibility of using Fiji Image J, a software commonly used in biology, to generate concept maps representative of large groups of students in any field and provide educators a novel synthesis of the use of R Studio and Gephi in examining students' understanding of chemistry topics in connection with gender, chemistry performance, and math proficiency.

The Future Role of the US in the Denuclearization of the Korean Peninsula

Zachary Wagonis
Sponsor: Jaime Jackson, Ph.D.
Political Science

The US has had a long-time presence in the Korean Peninsula, with a focus on diminishing the national security threat that North Korea poses with its nuclear program. US involvement has largely been met with stark resistance from North Korean leadership concerning denuclearization, despite diplomatic, economic and militaristic pressure being applied. In this study, we analyze what North Korea has to gain from continuing its nuclear program and what the US can do to best achieve denuclearization while avoiding armed conflict. The analysis factors in North Korea's economic situation and their potential security gain from the nuclear programs to estimate exactly how much of a boon those programs can be to their nation. With this information, we must then factor in past US interactions with other potential nuclear states, such as Iraq, and the plan of actions previously used. Using the information gathered, it is hypothesized that escalation or increased economic pressure will likely work to a lesser extent than using political ties, such as the trade war with China, to apply indirect pressure to North Korea.

Lipotoxic Injury Differentially Regulates Brain Microvascular Gene Expression in Male Mice

Nejma Wais
Sponsor: Amparo Villablanca, M.D.
MED: Int Med Cardiology (sac)

Hyperlipidemia is a risk factor for vascular disease and dementia, and chronic consumption of a Western Diet (WD) correlates with cognitive impairment. However, the molecular mechanisms are poorly understood. This pilot study investigated the nutrigenomicpathways by which the WD and hyperlipidemia generated in the low-density lipoprotein receptor deficient (LDL-R -/-) mouse regulate gene expression in brain microvessels. Five-week-old LDL-R-/- and C57BL/6J wild type (WT) control male mice were fed a chow or WD for 8 weeks. Differential gene expression, gene pathways, transcription factors, and non-protein coding RNAs were evaluated by genome-wide microarray and bioinformatics analysis of laser captured hippocampal microvessels. The WD resulted in differential expression of 1,972 genes. Much of differential gene expression was attributable to differential regulation of cell signaling proteins and their transcription factors, approximately 4% was attributable to differential expression of miRNAs, and 10% was due to other non-protein coding RNAs, primarily long non-coding RNAs (lncRNAs) and small nucleolar RNAs (snoRNAs) not previously described to be modified by theWD. Lipotoxic injury resulted in complex and multilevel molecular regulation of the hippocampal microvasculature involving transcriptional and post transcriptional regulation and may provide a molecular understanding for hyperlipidemia-associated dementia risk.

Long-term Changes in Transcription due to Neonatal Enteropathogenic *E. coli* Infection in Brain and Gut NOD1 Conditional Knock-out Mice

Olivia Walsh
Sponsor: Melanie Gareau, Ph.D.
VM: Anat Physio & Cell Biology

The microbiota-gut-brain (MGB) axis is essential to homeostasis, and dysbiosis of the microbiota appears in psychiatric, metabolic and intestinal disorders. To better understand the lasting effects of dysbiosis during neonatal development, we induced dysbiosis in neonatal mice via infection with enteropathogenic Escherichia coli (EPEC). Pattern recognition receptors (PRRs) of the innate immune system (including NOD1/2) are expressed in the brain, receive signals from the gut, and have specific expression patterns throughout development. Preliminary studies indicated wildtype adult mice infected with EPEC as neonates have increased expression of NOD1/2, RegIII-γ (gut), BDNF (brain), and TNF-a suggesting a pro-inflammatory state in the MGB axis. We used conditional NOD1 knock-out (CKO) mice to understand the role of NOD1 signaling in the gut (intestinal epithelial cells, Vil.Cre) or brain (hippocampal neurons, Cam.Cre). After extracting RNA from colon, ileum, hippocampus, and prefrontal cortex of uninfected vs. infected and transgenic vs. control tissue, we used qPCR to measure inflammatory marker expression. If NOD1 mediates deficits, we anticipate CKO mice infected with EPEC as neonates will have altered expression of pro-inflammatory genes. We aim to elucidate the pathways that regulate gut-brain communication, which may aid development of therapies for related disorders.

Socioeconomic Status and Insecure Attachment Styles in Children

Jessica Waltmon
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

The aim of this study was to explore the relationship between socioeconomic status and attachment styles in children ages 9-11 years old. Socioeconomic status (SES) was indexed through a composite of parents' education level (both parents), family income scaled as an ordinal variable, and both the participant's and the parent's subjective social status using the previously validated MacArthur Ladder scale. Attachment style was self-reported by children using the Experiences in Close Relationships-Revised scale. We used confirmatory factor analysis within a structural equation modeling framework to create a latent variable of SES. Then we regressed this SES variable onto both anxious insecurity and avoidant insecurity as predictors of SES, controlling for participant sex, and birth order. This created a model with acceptable fit with an RMSEA of .07, and a CFA of .87. In this model, SES was negatively related to avoidant insecurity (B = -.54, SE = .27, p = .046), but was not related to anxious insecurity. Results suggest that children from lower SES homes exhibit more insecure attachment styles, as self-reported by children.

Is Starch a Biomarker for Postharvest Chilling Injury in Tomato Fruits?

Keqing Wang
Sponsor: Diane Beckles, Ph.D.
Plant Sciences

Tomato (Solanum lycopersicum L.) is one of the world's most consumed but highly perishable vegetables. While refrigeration is effective in extending shelf life, tropical fruits such as tomato can experience Postharvest Chilling Injury (PCI), when stored below 12.5 degrees Celsius. Injuries are often detected when fruit is rewarmed, including lack of favor and poor visual and textural quality. Another indicator related to fruit quality is starch content, as it is broken down to sugars during ripening. A portion of the sugars is respired, providing energy for growth and maintenance, while some sugars accumulate, contributing to sweetness. Interestingly, fruit undergoing PCI characteristically show high rates of respiration. Our hypothesis is that starch may be broken down at higher rates for increased respiration due to PCI. To answer this question, we stored green tomatoes at varying low temperatures to produce fruits with mild, moderate and severe PCI. Under these conditions, quantitative and qualitative assays of starch contents will be analyzed in tomato fruit. We expect to see a correlation among starch content, ripening stages and the degree of PCI. Any data generated from this work will help us to understand tomato PCI and the biochemical role of fruit starch.

Improved Strength and Mechanical Properties Related to Microstructure of Carbon Fiber Reinforced Polymer(CFRP) Composites

Xingbo Wang
Sponsor: Subhash Risbud, Ph.D.
Materials Science&engineering

The use of carbon fiber reinforced polymers (CFRP) is a widely used technology in manufacturing industries, including aviation, automobile , and equipment manufacturing. CFRP is also used in the manufacturing of sports equipment and medical equipment. In the future, CFRP will play an important role in industries. Unique mechanical properties of CFRP make it the preferred material for high strength low density applications and thus CFRP composites research is of great value. We studied the relationship between the microstructure and mechanical properties of CFRP and explored the potential to improve material properties based on desired microstructures. Mechanical properties including Hardness, Young's Modulus, Yield strength, Ultimate tensile strength, and ductility are presented from our own data and literature. CFRP samples with uniform geometry are made to test these mechanical properties. And we used electron microscope to observe their microstructures. Based on testing methods and equipment, data is reliable. In this presentation the potential of CFRP composites will be emphasized as lighter, more affordable, and easier to manufacture materials.

Characterization of Native Starch Branching Enzymes in Three Potato Cultivars

Keyun Wang
Sponsor: Diane Beckles, Ph.D.
Plant Sciences

Potato is the 3rd most important staple crop globally with abundant starch, a critical source of carbohydrates for consumption. Starch Branching Enzymes (SBE) contribute largely to starch biosynthesis. In this study we explored the evolutionary relationship of plant SBEs among species by building a phylogenetic tree. Then, focusing on the three potato cultivars alone, we investigated the highly conserved domains of the SBE genes, after creating a protein alignment map which we annotated with the conserved and variable amino acid (AA) sequences. The difference in AA sequence is likely to cause structural and functional variability in SBE enzymes. Allelic variants among the SBEs of three cultivated potatoes were also studied after PCR amplification of the conserved region using genomic DNA. In addition, by conducting semi-quantitative RT-PCR, we observed variability in SBE mRNA expression among the three cultivars. Our initial results suggest that potato SBEs are grouped with other starchy tubers (e.g. sweet potato and cassava) but diverged from cereal crops. Most SBEs possess a structural similarity, but variants of AAs and alleles are also observed. These variations in AAs and expression may influence the structure and function of potato starch.

Human-Centered Design for Sustainable Menstrual Hygiene

Annie Wang
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

The majority of American menstruators address their period health with disposable pads and tampons. A reusable alternative is a menstrual cup which is worn inside the vaginal canal to catch, instead of absorb, blood. Cups can reduce landfill waste, provide longer durations of leakage protection, and save costs in the long-run. However, they are still overshadowed in popularity due to challenges associated with integrating the product into everyday life. Our project applies human-centered design to develop novel menstrual cups that prioritize accessibility and efficacy for users. This includes identifying factors for or against adoption of menstrual cups including environmental impact, ease of usage, cultural norms, financial incentives, health outcomes, and aesthetics. We achieve this goal by interviewing menstruators who range in their experience with, and enthusiasm for, reusable period products. We also analyze feedback on menstrual cup models available on the market. Our findings indicate that barriers to usage may include the learning curve for insertion and removal of current designs, higher up-front cost compared to disposable products, and discomfort with changing cups in public facilities. Guided by these findings, we utilize digital fabrication tools to prototype novel and user friendly menstrual cups to enable more sustainable personal hygiene practices.

Zinc and Antioxidant Status Following Excess Iron Supplementation of Newborn Rats

Hebeini Wang
Sponsor: Bo Lonnerdal, Ph.D.
Nutrition

Iron supplementation or iron-enriched formulas are often recommended to prevent iron deficiency in infants. However, studies show that high iron exposure to infants can also result in adverse effects, such as mineral interactions, oxidative stress, illness, and altered cognitive development. Therefore, the objective of this study is to evaluate how increasing doses of supplemental iron affects the distribution of iron and zinc in the brain and other organs during the early postnatal period. To accomplish this, we supplemented newborn Lewis rats with vehicle control (10% sucrose), or 10, 30, or 90 mg Fe/kg body weight as ferrous sulfate beginning postnatal day (PD) 2 until PD 10. Iron and zinc were quantified in the brain, liver, duodenum, spleen, and kidney using atomic absorption spectrometry and histology. Lipid peroxidation and expression of antioxidant genes will also be assessed to evaluate which tissues are affected by oxidative stress following iron dosing. Currently, our results show that zinc concentration significantly increased only in the liver of all iron-supplemented groups. With further findings, we aim to provide insight as to which developing organs are most affected by excess oral iron exposure, and whether the developmental effects of excess iron can be attributed to zinc interactions.

Optimizing Milk Oligosaccharide Profiles Through Changes in Dairy Cattle Diets

Zhe Wei
Sponsor: Daniela Barile, Ph.D.
Food Science & Technology

Human milk oligosaccharides (HMO) are the third most abundant solid component in human milk, after lactose and lipids. They are indigestible, complex sugars that have demonstrated roles in infants' immune system development by promoting the growth of beneficial bacteria and limiting pathogen adhesion in the gut. Infant formulas contain little to no HMO due to the limited availability of human milk and difficulty of synthetically producing the many complex HMO structures. Bovine milk oligosaccharides (BMO), however, have similar beneficial properties, and bovine milk is much more widely available. Current sources have low concentrations of BMO, but modifying environmental factors such as cow diet may alter BMO profiles or concentrations. This study investigates whether a high fiber dairy cattle diet changes the BMO profile of the milk produced, when compared to the BMO profile of cows fed a low fiber diet. Milk samples were collected from a crossover study, in which 72 cows were fed diets with two different fiber contents. The identification and relative quantification of BMO is being conducted via advanced liquid chromatography-mass spectrometry. We hypothesize that cattle fed the higher fiber diet will produce milk with BMO in higher abundance or a more diverse array of BMO.

Effect of Cyclic Peptide LXW7 in Promoting Neovascularization and Ischemic Wound Healing

Yifan Wei
Sponsor: Aijun Wang, Ph.D.
MED: Surgery

Up to 25% of the 29 million diabetic Americans develop serious foot ulcers, 65% of which become chronic wounds due to ischemia, a lack of oxygen caused by impaired blood vessel production. We identified a cyclic peptide, LXW7, which is capable of binding to integrin on the surface of endothelial progenitor cells and endothelial cells. LXW7's functionality includes the ability to activate vascular endothelial growth factor receptors and the ability to promote endothelial cell proliferation and maturation. We combined LWX7 with a collagen-binding protein mimetic DS-SILY in order to create a pro-angiogenic molecule named LXW7-DS-SILY. The molecule was used to functionalize small intestinal submucosa (SIS) extracellular matrix to generate the LXW7-DS-SILY-SIS scaffold which can be applied over open wounds. This scaffold was seeded with endothelial progenitor cells (EPCs) in a Zucker Diabetic Fatty rat model with ischemic wounds. Histopathology analysis demonstrates that treatment with LXW7-DS-SILY-SIS significantly improved healing rates and increased the abundance of new blood vessels. Our results indicate that LXW7-DS-SILY-SIS could potentially be used as a novel treatment in the future for diabetics with ischemic foot ulcers, reducing the amputation and mortality rate for patients afflicted with the disease.

AAV9-mediated Replacement of Choline Acetyltransferase Gene Deficiency in Mice

David Wei
Sponsor: Ricardo Maselli, M.D.
MED: Neurology

Choline acetyltransferase (ChAT) is a key enzyme that resynthesizes the neurotransmitter, acetylcholine, from acetyl-CoA and choline. Defects in the human gene encoding ChAT (CHAT) result in a complex genetic disease characterized by muscle weakness, autonomic deficit, and mental impairment. Knockout mice for Chat (Chat $^{-/-}$) are immobile and die shortly after birth. To circumvent this perinatal mortality, we have developed a conditional ChAT-deficient mouse by breeding homozygous floxed mutant mice (Chat $^{flox/flox}$) that possess loxP sites flanking Chat exons 4 and 5 to mice that express Cre-ER^{T2} (Cre recombinase-estrogen receptor T2). Injection of tamoxifen in these mice induces Cre-mediated excision of Chat exons 4 and 5, and downregulation of the chat gene. Injection of tamoxifen at early postnatal life resulted in 100% mortality. About 50% of mice injected during adult life survived, but developed weakness and autonomic deficit. Our current research efforts are focused on preventing the consequences of Chat downregulation by perinatally injecting human CHAT using an adeno-associated virus type 9 (AAV9) as a carrier. We hope that this will ameliorate the morbidity and mortality resulting from Cre-mediated downregulation of Chat, and that this method can be used for treatment of human disorders caused by ChAT deficiency.

Synthetic Approach to Optimizing Energy Density of a Redox Flow Battery

Julia Weidner
Sponsor: Louise Berben, Ph.D.
Chemistry

Redox flow batteries (RFBs) are gaining increasing levels of attention as a viable approach for grid-scale energy storage. This has become increasingly important in the context of storing renewable energy. RFBs differ from conventional batteries in that they are easily scalable, have long lifetime expectancy, and can store large amounts of energy without the risk of a dangerous discharge. My research focuses on synthesizing molecules made from Earth-abundant elements (ie. C, H, N, O, Al) to be used as RFB analytes. I will discuss the synthesis and characterization of analytes made by derivatizing known molecules called bis(imino)pyridine. These derivatives are more polar than the parent compound and are predicted to improve the analyte's solubility in acetonitrile. The expected lifetime of these analytes has been tested under battery-like conditions using a simple cell design. My experiments demonstrate that the analyte properties are suited for optimizing the energy density of an RFB.

Curious Aggies: "You're here to learn, right?": Undergraduates' Provocative Questions About Learning

Mahalia White
Sponsor: Kara Moloney, Ph.D.
Educ Effec Hub

The Curious Aggies project engages students in efforts to promote transparency and inclusivity in campus discussions about how to improve student learning. Co-designed and conducted by student assessment researchers, the purpose of the project is to identify the extent to which learning outcomes are transparent to students at a large, public, research university. In this academic presentation, undergraduate Student Assessment Fellows will present results from their student-led inquiry project. During the pilot, a Student Assessment Fellow asked a random sample of 50 undergraduates through either an in-person interview or an online survey 1) how they know what faculty expect them to learn; and 2) how they find out what faculty expect them to learn. The Student Assessment Fellows conducted a content analysis, and found that 66% of participants (n=35) determine instructors' expectations from the course syllabus; 34% (n=18) will ask someone, and perhaps most notable, that 21% (n=11) said that they find out after receiving a grade on a test or assignment. The findings raise provocative questions, including the degree to which course syllabi actually include learning outcomes; the sources to whom students turn to discover instructor expectations; and ultimately, how legible faculty expectations are to students.

Tracing Plastic Recycling Waste at UC Davis

Maaike Wielenga
Sponsor: Clare Cannon, Ph.D.
Human Ecology

People assume plastics thrown in recycling bins get recycled, but recent news about the global plastic waste trade has put that assumption into question. Are we being mislead about our environmental impact? Plastics that are not recycled contaminate our environment through incineration, landfilling, or pollution, causing adverse health effects for humans and other organisms. UC Davis is an important study site to further our understanding of plastic waste disposal, as an academic community with a population of approximately 63,000 and an institution of higher education committed to sustainability and zero waste. To this end, my research investigates what happens to plastic waste thrown in recycling bins at UC Davis. Preliminary research indicates that mixed waste recycling and the complexity of interlocking systems of global waste streams make tracking waste from UC Davis difficult. In order to answer this challenging question, I will interview institutional administrative officials and plastic waste industry professionals to trace plastic recycling waste flows from UC Davis. Implications of this research are further discussed. This research will be made available to the UC Davis community through a website and to UC Davis decision makers to inform UC Davis recycling policy through a policy brief.

Modern use of *Rape Hysteria* by Modern Masculinists Online

Kailea Wiese
Sponsor: Eric Dickson, Ph.D.
French & Italian

My presentation analyzes the form Rape Hysteria from online posts and comments in relation to masculinist beliefs. Hysteria was thought to be a physical manifestation of mental disease in women with various symptoms presented, which has been used historically to control women and delegitimize women's embodied experiences. Masculism is a movement composed of individuals who believe men's rights are in danger and so they must advocate for men's social issues. To masculinists, the phenomenon of rape hysteria is characterized by women overreacting regarding issues of sexual assault and rape, to the point of causing harm to men. Through the lens of the historical context of hysteria's usage and a characterization of masculinism, I examine masculinist ideologies and mythologies around women using Critical Discourse Analysis (CDA, a process that examines language in context of power structures, rhetorics, and assumptions in dominant discourse) from several posts and comments on Reddit. Through CDA, I show how masculinists see an androcentric world— indexing feminists with unearned privilege, corrupt power, and potential danger. This reveals a way discourse disseminates within an echo chamber, in this case to propagate negative attitudes towards women.

Screening and Exploring Regulatory Domains of Arabidopsis Transcription Factors

Shehan Wijesinghe
Sponsor: Patrick Shih, Ph.D.
Plant Biology

Regulation of gene expression is vital to proper cell function. Transcription factors regulate the expression of genes by binding to a section of DNA and regulating transcription of the adjacent gene. Although there is considerable interest in engineering transcription factors to build genetic circuits for various biotechnological applications, there has been little work done to characterize the domains that can tune the activation or repression of gene expression by transcription factors. Previously, we have built various synthetic transcription factors to enable the tuning of transgene expression in plants. We have characterized a library of candidate regulatory domains that modify gene expression in order to expand our ability to modulate expression with our synthetic transcription factors. Continued research into the functional domains of these domains will provide insight into how mutations in the genetic code can lead to transcriptional activation and repression, and thus modify gene expression. Uncovering this information will both improve our understanding of plant systems, and further the foundational knowledge needed for plant engineering.

Mathematical Modeling, Automated Manufacturing, and Verification Testing of Low Cost Magnetorquers for 3 Axis Control for UC Davis CubeSat Mission

Zoe Wilf
Sponsor: Stephen Robinson, Ph.D.
Mechanical & Aerospace Engr

This presentation discusses the ADCS magnetorquer coil development for REALOP, UC Davis's first, and completely undergraduate-led, CubeSat mission. In hopes to launch a platform for future Earth science based missions and offer guidance for other low-cost university nanosatellites, this presentation will discuss the optimization and manufacturing process for a single unit configuration of 1 air core and 2 torquer rods. Through extensive mathematical modeling coupled with physical testing for verification, a customized configuration can be designed and manufactured in-house. The selection of magnetorquer dimensions and materials were determined through research and analysis to meet system detumbling and desaturation requirements. To efficiently manufacture the prototype, a coil winder was designed, assembled, and programmed. This adaptive and modular coil winder is designed for reliability and repeatable prototyping. The information to create highly-customizable magnetorquer structure with a coil winding device can be utilized as tools by other universities and research institutions with little to no experience in CubeSat development by significantly lowering the barrier of entry and expanding mission scope.

Prison Censorship and the Constitution: Masking Political Imprisonment in the Age of Mass Incarceration

Tiana Williams
Sponsor: Jesse Drew, Ph.D.
Cinema & Digital Media

In its landmark ruling Thornburgh v. Abbott, 490 U.S. 401, the United States Supreme Court noted that banning access to all books inside prisons is unconstitutional under the First Amendment, and held that individual institutions should be granted "broad discretion" in examination for inappropriate content that is deemed "detrimental to the security, good order, or discipline of the institution" (1989). Since this critical case, a variety of books and materials have been banned from entering U.S. prisons, including Michelle Alexander's The New Jim Crow and works by revolutionary author and activist George L. Jackson. While censorship inside prisons, among other violations of constitutional and human rights, has remained the societal norm for many decades the contextual background necessary to examine the changes in prison censorship and policy are often neglected in many discussions and studies. With an in-depth analysis of the constitution and by demonstrating the voice of prisoner activists through oral histories, prison letters, and archival footage, this research shows how prisoner activism of the 1970s and the far-reaching prisoners' rights movement led to increased systemic repression along with the United State's concealment of the existence of political prisoners.

BioInnovation Group's Algae to Insulin Project: *Chlamydomonas* reinhardtii Chloroplasts as a Sustainable Biomanufacturing Platform

Alejandra Wilson
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

Biomanufacturing plays an ever increasing role in our society, responsible for creating products ranging from therapeutics to industrial chemicals to food products. However, the most popular chassis organisms in synthetic biology require large amounts of sugars, amino acids, and frequently, antibiotics and animal extracts. These inputs carry significant financial and environmental costs. Chlamydomonas reinhardtii is a single-celled eukaryotic algae whose chloroplast has been shown capable of producing therapeutic-grade proteins. C. reinhardtii is capable of photosynthesis, and requires as inputs only trace inorganic salts, a buffer, and a simple nitrogen source. We report our progress towards investigating the environmental sustainability of C. reinhardtii as a protein production platform, and our progress towards genetic construct design and algal strain engineering with mini-proinsulin as our primary candidate protein. As a BioInnovation Group at UC Davis research project, this project is entirely undergraduate run, and represents a new mode of expanding undergraduate co-curricular biotechnology education.

Modeling the Amorphous Na2Ge-GeSe2 Chalcogenide System

Max Win
Sponsor: Davide Donadio, Ph.D.
Chemistry

Li-ion batteries with polymer-electrolytes still have several disadvantages related to costs, safety, and materials' availability. It would be desirable to develop alternative storage devices comprising solid-state electrolytes and sodium ions, which may replace current Li-ion batteries for certain applications. The Na2Ge-GeSe2 chalcogenide glass-ceramic was proposed as a promising material to be used as a solid electrolyte for Na-ion batteries. The complex chemistry and structural heterogeneity of this material are hardly described by empirical potentials, calling for first-principles modeling. However, first-principles simulations involve high computational costs and cannot scale to the size and time scales necessary to characterize the functional behavior of this material, thus requiring a multiscale approach. Initially, we show that parameter-free ab initio molecular dynamics (AIMD) simulations reproduce the experimental properties of Ge-Se melts at different stoichiometry, and predict the structural variations induced by the inclusion of Na. In this study, we overcome the size and time scale limitations of AIMD by constructing suitable machine-learning potentials - based on the Chebyshev Polynomials paradigm (ChIMES) - with which we can simulate quenching from the melt and Na diffusion. This study will allow us to finally characterize amorphous Na-intercalated GeSe2 and predict its ionic conductivity at various conditions.

The Influence of Reverse Problem Solving on Undergraduates' Success with Stoichiometry Problems

Wylen Winchell
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

Chemistry students struggle with interpreting given information in problems and separating relevant information from distractors, causing failures in generating successful solutions. Chemistry educators have implemented different methods such as using solution maps to teach their students how to approach problems and successfully tackle them. However, the effectiveness of problem construction by utilizing given solutions on students' problem-solving achievement has not been studied yet. In this study, a group of chemistry students (N=45) participated in three think-aloud sessions. The group was divided into a control group (N=15) and an experimental group (N=30). During the pre-intervention session, all the students were asked to solve five stoichiometry problems while thinking aloud. After two weeks, the intervention session was conducted in which the experimental group was asked to construct eleven chemistry problems by examining the given detailed solutions. In the post-intervention session, both groups solved slightly modified versions of the pre-intervention questions in order to observe changes in their strategy, knowledge, and accuracy. The goal of this study is to better identify students' struggles with solving chemistry problems, and to examine the effects of problem construction as a potential method to increase students' success with problem solving in chemistry and other subjects.

Investigation of $Yb_{14-x}Lu_xZn_{1.7}Sb_{11}$ as a High-Efficiency, Atmospherically Stable Thermoelectric Material

Logan Winston
Sponsor: Susan Kauzlarich, Ph.D.
Chemistry

Thermoelectric materials efficiently convert heat to electricity. The thermoelectric figure of merit, zT, is described by the equation, $zT = sS^2T/\kappa$. We are investigating materials that maximize zT: increasing electrical conductivity (s) and Seebeck coefficient (S) while minimizing thermal conductivity (κ). Properties such as carrier concentration and Hall mobility will also be analyzed. $Yb_{14}ZnSb_{11}$ is a structural analog of $Yb_{14}MgSb_{11}$, a state-of-the-art thermoelectric material demonstrating a peak zT of 1.3 at 1273 K. The peak zT of the $Yb_{14}ZnSb_{11}$ system has shown to dramatically increase (~10x) after doping with rare-earth elements, lanthanum, and yttrium. Based on this research, we are investigating doping with lutetium in an attempt to achieve similar improvements. The compositions that have been synthesized are $Yb_{14-x}Lu_xZn_{1.7}Sb_{11}$ (x = 0.2, 0.4, 0.6, 0.8, 1.0). One issue facing large-scale, industrial synthesis of analogous thermoelectric materials is their inherent sensitivity to air and moisture. Previous studies, (lanthanum and yttrium doping) have shown similar materials to exhibit excellent thermal and chemical stability under standard atmospheric conditions and we expect comparable results in the $Yb_{14-x}Lu_xZn_{1.7}Sb_{11}$ series. This is another important factor as these thermoelectrics are designed for high-temperature thermal generators employed by NASA and JPL.

Parental Attention Directing and Its Effect on Joint Attention

Hannah Wodrich
Sponsor: Lisa Oakes, Ph.D.
Psychology

Joint attention refers to periods of time when two individuals show shared interest in the same object or event, and is critical for early-childhood interaction and learning. Recently, researchers have focused on how parents engage their infants in periods of joint attention. For example, after 11 months, children attend to objects most when mothers exhibit both verbal cues (e.g. "Look at this!") with non-verbal cues (e.g., pointing) (Deak et al. 2007). Additionally,"parentese", or the use of exaggerated language and movement, has been found to affect attention in infants as young as 6 months (Brand et al. 2002). Our goal is to examine how verbal and nonverbal cues influence 6-month-old infant attention (as measured by their touching) during play with their mother. In this study, 40 mother-infant dyads were provided with 4 toys. Mothers were asked to play naturally with their 6-month infants for 90 seconds. We coded touching of each toy by both the infant and the mother. We also coded and transcribed mother's infant-directed vocalizations, along with non-vocal cueing behavior, such as shaking or squeaking a toy. Our analysis of these measures will determine how infants' attention is influenced by these vocal and non-vocal cueing behaviors.

AAV9-mediated Replacement of Choline Acetyltransferase Gene Deficiency in Mice

Taylor Wolfe
Sponsor: Ricardo Maselli, M.D.
MED: Neurology

Choline acetyltransferase (ChAT) is a key enzyme that resynthesizes the neurotransmitter, acetylcholine, from acetyl-CoA and choline. Defects in the human gene encoding ChAT (CHAT) result in a complex genetic disease characterized by muscle weakness, autonomic deficit, and mental impairment. Knockout mice for Chat (Chat -/-) are immobile and die shortly after birth. To circumvent this perinatal mortality, we have developed a conditional ChAT-deficient mouse by breeding homozygous floxed mutant mice (Chat flox/flox) that possess loxP sites flanking Chat exons 4 and 5 to mice that express Cre-ERT2 (Cre recombinase-estrogen receptor T2). Injection of tamoxifen in these mice induces Cre-mediated excision of Chat exons 4 and 5, and downregulation of the chat gene. Injection of tamoxifen at early postnatal life resulted in 100% mortality. About 50% of mice injected during adult life survived, but developed weakness and autonomic deficit. Our current research efforts are focused on preventing the consequences of Chat downregulation by perinatally injecting human CHAT using an adeno-associated virus type 9 (AAV9) as a carrier. We hope that this will ameliorate the morbidity and mortality resulting from Cre-mediated downregulation of Chat, and that this method can be used for treatment of human disorders caused by ChAT deficiency.

Performing an Inclusive Campus: Digital Resource Accessibility for Gender Non-Binary Students at California Higher Education Institutions

Caroline Wolski
Sponsor: David Orzechowicz, Ph.D.
Sociology

The aims of this research are to identify and bring awareness to disparities of social inclusion in higher education. This study examines 20 gender-inclusive resources described on the websites of two-and-four-year accredited institutions in California and contributes to identifying gender integration and inclusion on California campuses. A website that exhibits diversity and gender inclusion may influence students who identify as gender non-binary in choosing a campus environment best fit for themselves. This is essential, because a campus may have accessible gender-inclusive restrooms; however, if the restrooms are not publicized on the campus website, a student may be unaware that the resource exists and where to find it. Findings showed that 44.2% of California Community Colleges (CCC), 95% of California State University (CSU) campuses, 100% of University of California (UC) campuses, and 39.7% of private non-profit institutions mention gender-inclusive restrooms on the institution website. Furthermore, 35.4% of CCC campuses, 87% of CSU campuses, 100% of UC campuses, and 20.6% of private non-profit institutions identify the location(s) of the gender-inclusive restrooms on the website. This study identifies resources specific to gender non-binary students available on California higher education campuses and examines how Student Affairs professionals understand the importance of these resources.

Helping Infants Learn Language: Do Parents Exaggerate Speech Sounds When Talking to Infants?

Wai Yan Emma Wong
Sponsor: Katharine Graf Estes, Ph.D.
Psychology

Caregivers often alter their speech when speaking to infants, using a speaking style known as infant-directed speech (IDS). The current study explores this phenomenon by investigating whether parents hyperarticulate, or exaggerate speech sounds, to make their speech more clear when talking to infants. Specifically, we are investigating how parents vary their production of "t" sounds in speech towards infants versus adults. We are coding emphasized and reduced "t" sounds (e.g. 'cheetah' pronounced with a clear "t" versus a "d" sound; 'cat' produced with a clear versus dropped "t"). Parents engage in two sessions of interactive tasks—first with their infant (11-month-olds and 19-month-olds), then with an experimenter. Parents are asked to incorporate a set of consistent target words to encourage the use of words with "t" sounds across both speaking registers. Sessions are audio and video recorded and analyzed for the "t" articulation as well as the positioning of the target words in sentences. Our preliminary data includes 10 participants, but coding is ongoing. We predict that parents try to present helpful language learning tools to their infants. Therefore, they will produce more clear speech to their infants than to adults, showing more hyperarticulation in IDS.

Identification of Tomato Signaling Factor Involved in Lignin-based Resistance to *C. campestris*

Caitlin Wong
Sponsor: Neelima Sinha, Ph.D.
Plant Biology

Cuscuta campestris (C. campestris) is a major parasitic plant that affects crop production all around the world. C. campestris forms specialized structures called haustoria when in physical contact with host plants. Haustoria form vascular connections between C. campestris and their hosts, thus allowing the transportation of water and nutrients from the hosts to the parasite. C. campestris is capable of decimating the production of important crops, including tomatoes, soybeans, and potatoes. To reduce agricultural damage caused by parasitic plants, we must further understand parasite-host interactions. In Heinz tomatoes, we discovered that parasite-resistant cultivars accumulate lignin in the stem cortex, preventing C. campestris infestation. Based on differential gene expression analysis, we identified an R-type protein with a coiled-coil, nucleotide-binding site and a leucine-rich (CC-NBS-LRR) gene in these tomatoes, which we named Cuscuta Receptor for Lignin-based Resistance 1 (CuRLR1). To understand its role in this lignin-based resistance pathway, we transiently overexpressed CuRLR1 in tomato cultivars susceptible to C. campestris infestation. The overexpression of CuRLR1 only induced lignification in the presence of C. campestris, which indicates CuRLR1 may serve a signaling role in this resistance response. These findings will enable deployment of directed molecular breeding programs and assist in developing parasite resistant crops.

Calibrating the Next Generation of Neutrino Detectors

Deangelo Wooley
Sponsor: Robert Svoboda, Ph.D.
Physics

Annie is a neutrino detector at Fermi national lab that focuses on understanding the rate of neutron caoture after a neutrino interacts with a neutron in a water molecule. An Americium Beryllium source is a radioactive material that gives off neutrons and gammas at a set rate. When placed in a scintillator with gadolinium loaded water we can determine the capture efficiency of neutrons by the gamma rays emitted. We need to know this, because (Annie) will shoot a neutrino beam at the water in the scintillator. This interaction will cause a water molecule to split into its subatomic particles. And we want to determine how efficient the gadolinium is at capturing the neutrons. The (AmBe) source will be placed at specific heights within the scintillator to determine neutron capture efficiency in a liquid base scintillator. The variation in heights will let us know where the highest probability of neutron detection will be at. Knowing this will give us a better insight as to why neutrinos behave the way that they do at these particular energy levels.

The Effect of Anthropogenic Noise on Provisioning Behavior in Adult Tree Swallows (*Tachycineta bicolor*)

Caitlin Wright
Sponsor: Gail Patricelli, Ph.D.
Evolution & Ecology

Anthropogenic noise, specifically traffic noise pollution, is prominent in urban areas. This noise can alter bird behaviors that contribute to reproductive success, such as communication, vigilance, and provisioning. In this study, we examined how anthropogenic noise impacts the provisioning behavior of tree swallows (Tachycineta bicolor) and how this behavior may differ between males and females. We exposed nest boxes to playbacks of artificial noise during the breeding season and transcribed the number and length of provisioning visits for males and females from video recordings. We hypothesized that provisioning rates decrease in noisy areas, with greater effects on female birds. Our hypothesis is supported by research that shows birds increase vigilance when exposed to anthropogenic noise, decreasing available time for provisioning. Noise also hampers communication between parents and nestlings, which may hinder parents' ability to hear hunger signals from nestlings. Additionally, during settlement, female tree swallows choose nest boxes in quieter locations more often than males, which indicates that they may be more sensitive to noise than their male counterparts. Implications of noise sensitivity in tree swallows may include a significant decrease in provisioning of birds as a result of urban development, thus decreasing fitness and impacting the overall population.

Factors that Limit *Armillaria* Growth and Infection of Walnut Plantlets

Yuan Wu
Sponsor: Patrick james Brown, Ph.D.
Plant Sciences

Tree crops such as walnuts are susceptible to root rot caused by Armillaria mellea, a wood rotting fungus. Armillaria infects the roots and girdles the crown, reducing water and nutrient uptake, which slowly deteriorates the health of the crop. This pathogen causes economic loss in agriculture and is a problem because available control methods are not very effective. Understanding how Armillaria infects plants is valuable for designing ways to prevent infection and to test plants for genetic resistance. It has been demonstrated that sterile, in-vitro grown walnuts, almonds, and grapes can be infected by Armillaria rapidly. However, in non-sterile conditions, walnut plantlets grown in inoculated woodchip medium became infected only after several weeks or months. This slow infection might be due to microorganisms suppressing Armillaria growth. Results from inoculating medium with Armillaria after autoclaving compared to unautoclaved medium show that Armillaria does not grow on the latter. Although autoclaving eliminates viable microbes, we also hypothesized that autoclaving creates a food source that promotes Armillaria growth, rather than the lack of microbes. To test these alternative hypotheses, 1. benomyl and streptomycin will be used to suppress microbes without autoclaving and 2. medium will be autoclaved and recontaminated before introducing Armillaria.

Novel Bioengineering Approach for Efficient In Vivo Fermentation Product of siRNA against PD1 and PDL-1 for Cancer Therapy

Halley Wright
Sponsor: Aiming Yu, Ph.D.
MED: Biochem & Molecular Med

As discovered in past research, short interfering ribonucleic acids (siRNA) can regulate gene expression via RNA interference. Therefore, siRNA can potentially serve as cancer therapeutics by blocking atypical cell growth and division. The Food and Drug Administration has found potential in siRNA as a drug by approving the siRNA Patisiran to treat Hereditary transthyretin-mediated amyloidosis (hATTR). In this study, we will be using novel bioengineering techniques to construct siRNA to target PD1 and PDL-1 genes. In normal cells, PD1 and PDL-1 act as immune checkpoint proteins that guarantee appropriate immune system activation. The binding of PDL-1, which has a high expression in tumor cells, to T-cell PD1 receptors inhibits the cytotoxic response, allowing the tumor cell to evade apoptosis. For production, Escherichia coli will be transformed and overexpressed with a plasmid incorporating our siRNA sequence with a tRNA carrier. To purify the siRNA, an anion exchange fast protein liquid chromatography (FPLC) will be performed. Purity will be confirmed with a high-performance liquid chromatography (HPLC) assay. Endotoxin level will then be verified. In the future, more assays will be done to study the potential of siRNA against PD1 and PDL-1 as a cancer therapeutic both in vitro and in vivo.

Comparative Analysis of Retinal Visualization Methods of a Mouse Model of Diabetic Retinopathy

Yanying Wu
Sponsor: Zeljka Mcbride, Ph.D.
MED: Eye Center

Diabetic retinopathy(DR) is an ocular complication that occurs due to diabetes. In diabetes, an increased blood sugar level causes damage to blood vessels in the back of the eye (retina). Small nucleic acids, microRNAs have recently been identified as promising therapeutic agents. The DR mouse model was used in our lab to determine whether our candidate microRNAs can be used as potential inhibitors of DR. The object of this pilot project was to identify which imaging technology would be the most useful to gather the data over a period of time. There were two groups, Group1: control group (PBS injections) and Group2: therapeutic injections. Animals were imaged at the following time points: 0, 7 and 30-days, using in vivo imaging with Micron IV and in vitro imaging of retinal flatmounts followed by confocal imaging. The images were compared between these two techniques at 30-days time point. Our results suggest that in vivo imaging has the advantage of multiple time points with the same animal, while in vitro imaging gave more details, but the animal can be analyzed at just one time point. In conclusion, a combination of the two imaging techniques will be applied to achieve the best results.

Using Yeast to Convert Almond Hull Hydrolysate into Protein-rich Material

Angela Wu
Sponsor: Kyria Boundy-Mills, Ph.D.
Food Science & Technology

Yeasts are unicellular fungi that consume sugar to produce their cellular components. Some yeasts are currently used in livestock feed as a high protein supplement. These yeasts are unable to utilize the sugar galacturonic acid, a monomer of pectin, efficiently. Galacturonic acid is a dominant carbon source in almond hulls, low value by-products produced during almond harvesting. The goal of this research was to identify yeasts that can metabolize a large proportion of almond hull carbon compounds while producing high amino acid concentrations essential for animal feed. By doing so, we will be able to reduce almond industry waste while maximizing sustainable sources of protein for livestock. The Phaff Yeast Culture Collection at UC Davis contains over 1,000 yeast species which allowed for the selection of strains based on promising characteristics such as the potential to accumulate high protein concentrations. They were screened in laboratory media with nutrients found in processed almond hulls, then cultured in real almond hull hydrolysate. Then, we determined the total protein and amino acid composition. We found that two strains were able to successfully consume galacturonic acid in lab media and are continuing to confirm its ability to do so in real almond hull hydrolysate.

Analyzing the Effect of Assignment Structures on Students' Problem-solving Performance in Chemistry

Ruohan Wu
Sponsor: Ozcan Gulacar, Ph.D.
Chemistry

The questions in the practice assignments given to students in the form of worksheets or other formats are often grouped by chapter, topic, or concepts. There is a great emphasis on categorization. Most of the end-of-chapter problems in chemistry textbooks are organized by sections. Although this was done with the intention of helping students navigate the assignments more easily and practice in order, it is not what they are expected to do during the tests. There is a mismatch between what they practice on and how they are tested. The goal of this study is to examine the influence of the structure of the assignments on students' problem-solving performances. Two groups of students from chemistry classes will be recruited to participate in this study. Each group will have the same length of practice and identical questions with only one difference. The experimental group will have assignments with mixed questions, while the control group will have traditional assignments with the questions organized around chapters and topics. Students will complete three two-hour long sessions during the weekends. Evaluation of their progress will consist of their written thinking process and one pre-test and three post-tests, with one given after each problem-solving session.

Attachment Insecurity and Higher Levels of the Interleukin6 (IL-6) Inflammation Marker in Childhood

Katie Wyant-Stein
Sponsor: Camelia Hostinar Caudill, Ph.D.
Psychology

According to attachment theory, unresponsive caregiving or inappropriate responses to the child's needs can result in an insecure attachment relationship. Recent research has indicated that attachment insecurity might be a factor in chronic inflammation and autoimmunity with an increase in Interleukin6 (IL-6) inflammatory marker. Our current study aims to further investigate the relationship between attachment insecurity and inflammatory markers in childhood. This study included 102 participants who were 9-11 year old children (Mean age = 9.9 years old, SD = .58), 42% identified as female. Researchers administered the Experience and Close Relationships (ECR) scale to measure attachment during a laboratory visit. Blood samples from participants were collected and assayed in order to examine the inflammatory marker IL-6. Analyses will test the hypothesis that participants higher in attachment insecurity have higher levels of the inflammatory marker IL-6 compared to participants with a secure attachment. This study has important implications regarding the physical health outcomes linked to inflammation that may be mediated by attachment relationships in childhood.

Media Analysis of the Changing Notions of Hunger, Charity, and Nutrition Assistance

Emma Wynne
Sponsor: Rafi Grosglik, Ph.D.
History

Sociological research about food charity is fairly comprehensive. There is extensive literature about the culture of food banks and the social dynamics that result from charity. However, there is a gap in analysis about the relationship between media and the policy that defines hunger and grants certain rights to those who meet a particular standard. Using content and discourse analyses of 573 New York Times articles, this research examines how hunger and charity are framed and how these frames interact with the changing requirements and limitations of the Supplemental Nutrition Assistance Program. The analysis revealed that charity has in many ways taken on the burden of nutrition assistance policies. This article argues that the discourse and the structure of these interacting institutions fail to address the real roots of hunger and ultimately perpetuate issues of hunger. It contends that even the language about hunger and charity inevitably privileges wealthy and corporate actors.

Bilingual Skills and Executive Function: English-Spanish Bilinguals in Dual Language Immersion Programs

Yuxuan Xiang
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Existing research shows that executive function (EF) is associated with vocabulary, word reading, and reading comprehension. Past research has focused on monolinguals, but there is less research on bilinguals. Furthermore, research with bilinguals has mainly been conducted with bilinguals from low socio-economic status (SES) homes. To fill the gaps in previous research, this study examined 30 English-Spanish bilingual second-graders (14 boys,16 girls), from high SES English-speaking families, enrolled in a Spanish Dual Language Immersion program since kindergarten. EF was collected using the Dimensional Change Card Sort task on the NIH Toolkit. English and Spanish receptive vocabulary were collected using the Peabody Picture Vocabulary Test. Decoding and reading comprehension was collected with the letter-word identification and passage comprehension subtests of the Woodcock-Johnson Test in both languages. Results show that on average, bilinguals had higher English vocabulary than Spanish, but their Spanish skills were equivalent to age-matched peers. On average, bilinguals' Spanish word reading was higher than their English word reading. Correlational results show that EF was significantly associated with receptive and expressive English vocabulary, but not with Spanish. These findings give a better understanding of higher SES bilinguals' language, literacy and EF skills, disentangling the effects of SES and bilingualism.

Visual Representation of UC Davis' Nitrogen Footprint

Breanna Xiong
Sponsor: Benjamin Houlton, Ph.D.
Land Air & Water Resources

Nitrogen is an important nutrient found and used throughout human and natural ecosystems. Worldwide, advanced nitrogen fertilizer technologies are estimated to support food production for over 3 billion people while developed economies have seen gains in nitrogen use efficiency by crops. However, excess amounts of reactive nitrogen can lead to declines in global health, biodiversity, and air and drinking quality when it is lost from soil. A nitrogen footprint provides a standardized measure for the amount of reactive nitrogen released by an entity, such as a university. Using ArcGIS Pro, which is a mapping application that allows us to represent numerical data spatially, we created an interactive map of the embodied and local emissions of UC Davis based on the 2018 nitrogen footprint that the UC Davis Office of Sustainability calculated. We focused on emissions from major contributing sectors such as food, utilities, transportation, research, and wastewater, as well as fertilizer and refrigerants. By visualizing the nitrogen emissions data, we hope to help individuals understand the source of nitrogen emissions on campus and assist people in making more sustainable lifestyle choices. Additionally, we hope to help campus decision makers understand the impact of operations and highlight opportunities for reductions.

Developmental Milestones in the *Gfap* Mutant Rat Model of Alexander Disease

Steven Xiong
Sponsor: Robert Berman, Ph.D.
MED: Neurological Surgery

Alexander Disease (AxD) is a progressive and fatal neurological disorder that causes deficits in cognitive function as well as physical ability. The disorder is caused by a mutation in the glial fibrillary acidic protein (GFAP) gene which results in elevated levels of GFAP protein, accumulation of abnormal protein aggregates in astrocytes called Rosenthal fibers, and loss of white matter in the brain. Behavioral features include delayed development, motor dysfunction and cognitive impairment. To better understand the disease, a rat model of AxD has been generated that reproduces much of the clinical pathology. Because AxD symptomatology can occur early in development we characterized neonatal behaviors that serve as milestones of brain maturation. Specifically, performance of newborn rats was assessed in a series of developmental tests on postnatal days (PND) 2, 4, 8, 10, and 12. There were no differences in the appearance of developmental milestones between AxD and normal rats. However, AxD rats with the Gfap mutation showed significantly lower body weights than normal control rats starting at PND 21. The severely delayed juvenile growth discovered provides a strong model of the physical decline exhibited by humans with Alexander Disease. These results will be informative for future studies assessing the efficacy of treatments.

Sustainability in the Boba Industry

Julie Xu
Sponsor: Thomas Maiorana, M.F.A.
Department Of Design

The purpose of this research is to improve the sustainability of the boba industry through human-centered design practice. Boba, or bubble tea, is a trendy drink from Southeast Asia, which is typically iced tea mixed with sugar and milk or other flavourings, alongside tapioca balls or other supplemental desserts at the bottom. Since boba drinks are typically served in disposable cups paired with plastic straws, this product creates growing waste that goes into landfills. Unlike the coffee industry, boba industry has been in the market for a shorter period of time; therefore, less research and innovations have been done to improve its sustainability. To understand the motivations of boba users, I collected qualitative data from conducting user interviews and I obtained quantitative data from various surveys and life cycle analysis. Then, using the synthesized data in the user experience report, I will arrive at a solution. While the specific solution has yet to be determined due to the methodology of this research, the goal is to develop a working prototype that helps making the boba industry more sustainable.

The Underlying Determinants of Hate Crime: An Economic Analysis

Ian Xu
Sponsor: Jeffrey Williams, Ph.D.
Ag & Resource Economics

Most perpetrators commit crimes for personal gain and/or to harm victims. However, unlike these perpetrators, those that commit hate crimes wish to harm victims and sections of society because of characteristics they dislike, which almost everyone agrees is especially vile. While most states have penalty enhancement laws against hate crimes, these laws cannot be unreservedly relied on—hundreds of thousands of hate crimes continue to occur each year, with a large proportion often going unreported. After conducting a preliminary regression analysis with random and fixed effects on data primarily gathered by the Bureau of Justice Statistics, FBI, and U.S. Census Bureau, results suggest race, poverty rates, median income, and justice system expenditures are of significant correlation with the number of hate crimes that occur in each state. With this relationship in mind, federal, state, and local governments, in addition to NGOs, can get a deeper understanding of the entire system that sows divide in our nation, and can best allocate resources to bring this nation closer together.

Producing and Characterizing SMAD4-GFP Reporter for BMP Signaling Dynamics

Andy Yan
Sponsor: Dominik Haudenschild, Ph.D.
MED: Orthopaedic Surgery

Bone Morphogenetic Protein-2 is a pleiotropic growth factor that can induce bone growth. Recombinant human BMP2 (rhBMP2) is currently the only Food and Drug Administration (FDA)-approved osteoinductive growth factor used by clinicians as a bone graft substitute for fractures and spinal fusions. However, the exponential rise in rhBMP2 use is associated with an increased side effect profile that includes ectopic bone formation, osteoblast-mediated bone resorption, and inappropriate adipogenesis. As effective bone healing in humans requires a high concentration of rhBMP2 (1.50 mg/mL), which exceeds the physiological protein amount produced in nanograms under normal bone repair conditions by one million-fold, the incidence of side effects simultaneously increase. BMP2 regulates the expression of osteogenesis genes via SMAD4 protein recruitment and nuclear translocation. Having the cells express a SMAD4 protein tagged with a Green Fluorescent Protein (SMAD4-GFP) through transfection will allow us to monitor the SMAD4 nuclear translocation via fluorescent microscopy and the subsequent expression of osteogenesis genes. By monitoring the SMAD4-GFP nucleo-cytoplasmic shuttling, we hope to gain a better understanding of the BMP pathway to optimize the growth factor conditions needed for osteogenesis and to subsequently decrease the side effects from current treatments of rhBMP2.

Systematic Analysis of Pathways Affecting Multi-Invasion Recombination

Kevin Yan
Sponsor: Wolf Heyer, Ph.D.
Microbiology & Molec Genetics

Failures in DNA repair create genomic instability, caused by mutations at the DNA level, but also changes at a chromosomal level. These chromosomal instabilities can manifest as changes in the number of chromosomes or in rearrangements with an extreme manifestation in chromothripsis, where one event may include thousands of individual breakpoints at different genomic locations. Multi-Invasion Recombination (MIR) is caused by an error in the double-stranded break repair mechanism, homologous recombination. Instead of invading one homologous sequence to repair a double stranded break, MIR uses two homologous sequences at the same time. This causes the fusion of the homologous donor sequences, and leaves behind broken donor chromosomes, which can cause additional rearrangements throughout the genome. To study this, we use the LYS2 gene in Saccharomyces cerevisiae. The LYS2 gene is split into three segments, LY, S2, and YS, each letter representing a quarter of the LYS2 gene. A double stranded break is induced at the YS sequence, which may lead to a MIR event. By analyzing how genes used in homologous recombination affect the occurrence of MIR, and what rearrangements are seen using different donor chromosomes, we can better understand the role of MIR in genetic diseases such as cancer.

The Downregulation of WNT4 Promotes Tumor Progression in Pancreatic Ductal Adenocarcinoma *In Vitro*

Hsien Yi Yang
Sponsor: Changil Hwang, D.V.M.,Ph.D.
Microbiology & Molec Genetics

Pancreatic cancer is one of the most lethal malignancies, with a 5-year survival rate of less than 8% due to early metastasis and high chemo-resistance. It has been reported that WNT signaling is frequently activated in pancreatic ductal adenocarcinoma (PDA) and contributes to tumor cell proliferation. We hypothesize that a specific member of the WNT family plays an important role in PDA progression. Among WNT family members, we found that WNT4 was significantly downregulated in metastases compared to primary tumors and associated with poor prognosis. Gene ontology and gene set enrichment analyses of PDA patient data revealed that the pathways such as Myc, E2F, and the G2M checkpoint were enriched in WNT4-low patients. In addition, the pathways involved in neuronal activities and calcium ion channel properties, were enriched in Wnt4-high patients. To determine the effect of WNT4 in PDA, we carried out a short hairpin RNA interference experiment against the Wnt4 gene in a murine pancreatic cancer cell line. The depletion of Wnt4 resulted in the increased anchorage-independent growth in vitro, which warrants further investigation in vivo. We concluded that Wn4 drives a non-canonical signaling for PDA progression in vitro with a correlation to the involvement of calcium ion binding.

Cloning Resistance Genes in Lettuce Using Downy Mildew Effectors

Sharon Yang
Sponsor: Richard Michelmore, Ph.D.
Plant Sciences

Lettuce downy mildew is a plant disease caused by the pathogenic oomycete Bremia lactucae. B. lactucae enhances infection by secreting effector (Avr) proteins into lettuce cells. Lettuce plants with innate resistance to downy mildew contain resistance (R) genes. These resistance genes produce resistance proteins that, upon recognition of an effector protein, induce a hypersensitive cell death response (HR) that prevents the spread of the pathogen by causing cell death in the infected area. This research aims to identify functional R genes from candidate R genes, which poses a challenge because they are highly clustered in the lettuce genome. To facilitate the identification process, we utilize previously cloned Avr genes by co-expressing them with candidate R genes. If subsequent HR is observed, then it can be established that the candidate gene is a true R gene. Through this method, we have recently identified an Avr-R gene pair that induced HR. Our ultimate goal is to construct a library of Avr-R gene pairs, which would enable stacking of the most relevant R genes in lettuce to counteract infections from B. lactucae.

Assessing Health Disparities in the *Sacramento Hmong Community*: Relationship Between Income, Education, and BMI

Eric Yang
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

During their settlement in the late 1970s, the Hmong faced extreme incomprehensible changes leading to difficulty adjusting to American society as Secret War refugees from Laos. Since their settlement, the Hmong population has continued to rank low on socioeconomic status, income level, education, and health when compared to other Asian minorities. This study aims to analyze possible health disparities observed in the Sacramento Hmong community by conducting demographic surveys and health vitals. During June-August 2019, surveys and vitals were collected from participants at Hmong cultural events such as age, gender, annual household income, formal education, blood pressure and BMI. Emerging data suggests that income and education level play major factors in level ranges of BMI. Data shows participants with higher income and educational levels had lower BMI ranges (p=0.05), suggesting BMI-related inequalities exist among the Hmong population. The Hmong's unique religious and cultural beliefs, distrust in Western medicine, and heavy dependence on government assisted programs are discussed in this study as possible attributes towards the relationship between income, education and BMI found. To reduce socioeconomic inequalities of BMI, inclusive and multifaceted interventions are required to address the observed inequalities, particularly the higher BMI average in certain socioeconomic groups.

Assessing Health Disparities in the *Sacramento Hmong Community*: Relationship Between Income, Education, and BMI

David Yang
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

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Assessing Health Disparities in the Sacramento Hmong Community: Relationship Between Income, Education, and BMI

Thad Yang
Sponsor: Christian Bohringer, M.D.
MED: Anesth & Pain Medicine

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Introducing Bayesian Statistics to Social Science Majors Using Rstan

Xiaoxiao Ye
Sponsor: Shelley Blozis Villarreal, Ph.D.
Psychology

Applications of Bayesian methods are increasing in the social and behavioral sciences, but they are not typically taught to undergraduate majors in these fields. This is likely due to a general effort to teach introductory-level statistics from a frequentist perspective, despite the highly intuitive appeal of Bayesian methods. Teaching Bayesian methods to students from the social and behavioral sciences can be challenging because Bayesian methods require an understanding of a likelihood function, specification of priors, and interpretation of posterior distributions, along with a need for specialized computer software. We describe a set of teaching modules that we used to introduce these basic concepts underlying Bayesian methods to students enrolled in an intermediate statistics course (i.e. an upper division undergraduate/introductory graduate statistics course) using RStan. Intermediate statistics courses commonly use R to carry out course assignments. RStan uses R as an interface for accessing the analytical capabilities of Stan, making Rstan a natural Bayesian software choice.

Science to Empower: Environmental Conflicts in Indigenous Ecuador

Anqi Ye
Sponsor: Mark Lubell, Ph.D.
Environmental Science & Policy

Environmental problems in Ecuador have led to disproportionate impacts in Andean and Amazonian indigenous communities. Environmental conflicts are interesting to study in Ecuador due to the abundance of natural resources, biodiversity of the landscape, and diversity of urban and indigenous communities that use the environment in different ways. By using the EJAtlas, a global tool documenting environmental justice (EJ) conflicts, we analyze cases in Ecuador for different tactics of violence, forms of community mobilization, and multi-sector (government, corporate, community-based) actors involved. We observe patterns in how communities' methods of resistance and the different magnitudes of violence relate to whether cases achieved justice or not. We expect to see domestic and international violence in certain geographical regions, neo-extractive activities in biodiverse hotspots, and an overall lack of access to legal justice and assistance, which may be leading some communities to use alternative strategies outside of existing formal legal tools. This project aims to better understand how certain tactics of environmental violence, involvement of different types of actors, and forms of community resistance and mobilization influence the visibility and outcomes of EJ conflicts, emphasizing the importance of monitoring, documenting, and supporting environments and communities on the frontlines of mega-projects and resource exploitation.

Developing a Reference Sequence Library for Mexican Free-Tailed Bat Prey

Khyana Yearwood
Sponsor: Andrea Schreier, Ph.D.
Animal Science

An estimated 250,000 Mexican free-tailed bats (Tadarida brasiliensis) reside in the Yolo Bypass which supports rice agriculture, one of the most important crops in the world. Mexican free-tailed bats provide ecosystem services to local farmers by consuming agricultural pests. Working with Ecology graduate student Ann Holmes, we collected ~300 guano samples in summer 2019 to determine diets of Mexican free-tailed bats. Previous studies determined diets through dissection and morphological identification, but identifying digested prey is difficult. With genetic techniques we can refine prey identities, but we need prey reference sequences to compare with DNA sequences extracted from guano. Reference sequence libraries provide a collection of genetic barcodes that allow the matching of DNA to species. This project will develop a reference library of regional agricultural pests. Insect sequences will be found through searches of genetic databases such as GenBank and Barcode of Life. Insects not genetically databased will be Sanger sequenced and accessible to other researchers. If time permits, we will expand our study using quantitative PCR (qPCR) genetic assays to see if these organisms are present in extracted DNA from bat guano. This research will help identify the contribution of Mexican free-tailed bats to local and sustainable agriculture.

An Investigation of Writing in Biology

Danielle Yee Litt
Sponsor: Daniel Melzer, Ph.D.
University Writing Program

Writing is essential. Whether we are texting friends, posting on a blog, or typing an essay, writing is a form of communication that has been integrated into every aspect of our lives. Although not a common association, a significant portion of a biological laboratory researcher's career is comprised of writing. With the goal of providing prospective biology researchers information about the role of writing in their future career, I will explore the different types of writing that are most prevalent in the careers of biology-focused scientific lab researchers. Additionally, I will search for common practices students can adopt to thrive when writing in biology. To obtain this information, I will conduct interviews with professors who specialize in the field of biology and analyze various biology writing guides. Through this study, I hope the inherent connection between writing and the sciences becomes more evident in the minds of future biology researchers.

Investigation of C-H Insertions with Donor/Donor Rhodium Carbenes and Applications to Targeted Synthesis

Kaia Yellowhorse
Sponsor: Jared Shaw, Ph.D.
Chemistry

Many core structures of desired pharmaceuticals are densely substituted and require a high degree of stereocontrol to synthesize. These core structures can be achieved through intramolecular C-H insertion of a dirhodium-generated carbene. The carbene reactivity is dictated by its adjacent pendant groups and subsequently designated as donor or acceptor groups. Of which, donor/donor groups have shown some of the highest chemo-, regio-, and stereoselectivity for intramolecular C-H insertion reactions, albeit with lower overall reactivity. Here, we report the efforts to probe the mechanism of these donor/donor cores using cyclopropane-based substrates, as well as the development of highly reactive, novel achiral dirhodium catalysts. These findings have informed ongoing targeted synthesis efforts for asymmetrically synthesizing a subset of xanthone natural products and other biologically relevant compounds using this C-H insertion methodology. Future work revolves around the synthesis of a library of xanthone analogs for biological screening and optimizations of current synthetic route.

Application of Microscopy with UV Surface Excitation (MUSE) for Deceased Donor Kidney Biopsy Assessment

Felicia Yen
Sponsor: Kuang-yu Jen, M.D.,Ph.D.
MED: Pathology & Lab Medicine

Histologic assessment of deceased donor kidney quality for kidney transplantation is currently performed using frozen sections since rapid reporting of the results is required. However, the reliability of the diagnoses is often suboptimal given several factors, including the limitations presented by frozen sections. Fresh kidney tissue obtained from otherwise discarded portions of nephrectomy specimens were used in this study. MUSE was chosen as the modality for microscopic imaging of the tissue given its ability to rapidly image a flat surface of fresh unfrozen tissue. Small portions of kidney parenchyma were subjected to several conditions for optimization of the protocol. All tissues were stained with Rhodamine and Hoechst and were subsequently imaged using a MUSE instrument. Images were color mapped to create an H&E stain appearance. Rapid microwave fixation and specimen sectioning with a vibratome created the best images for histologic evaluation without significantly lengthening the time required from start to finish, which is typically 15 minutes for a frozen section. These images showed no evidence of artifact since the tissue was not frozen and did not require sectioning using a cryostat. MUSE offers a promising alternative to rapid slide-free and artifact-free histologic evaluation of deceased donor kidney biopsies.

Gender Differences in Behavioral Strategies for Delay of Gratification

Lauren Yen
Sponsor: Daniel Choe, Ph.D.
Human Ecology

Early success in delaying gratification has been associated with positive developmental outcomes such as socioemotional competence, better mental health, future career success, and greater relationship quality. Studies of children's self-regulation have found that girls typically perform better than boys on delay of gratification tasks, which measure impulse control; however, it remains unclear which behaviors contribute to girls' better task success. A sample of 70 preschool-aged children (M = 50.8 months, SD = 4.77, 48.6% girls) performed a gift delay task in which children were left alone for three minutes and told not to touch a gift placed in front of them. Task success was defined by whether or not they touched the gift. The following behaviors were behaviorally-coded during the task in ten-second increments: focusing on object, behavior distraction, attention distraction, and passively waiting. With preliminary data (n = 28), there is a marginally significant gender difference in task success in the expected direction, but with a larger sample we expect to find a significantly higher success rate in girls, attributing their success to behaviors in which attention is averted from the gift. Children's ability to self-regulate in early childhood provides a basis for greater academic development and social relationships.

Bilingual Skills and Executive Function: English-Spanish Bilinguals in Dual Language Immersion Programs

Jillian Yick
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Existing research shows that executive function (EF) is associated with vocabulary, word reading, and reading comprehension. Past research has focused on monolinguals, but there is less research on bilinguals. Furthermore, research with bilinguals has mainly been conducted with bilinguals from low socio-economic status (SES) homes. To fill the gaps in previous research, this study examined 30 English-Spanish bilingual second-graders (14 boys, 16 girls), from high SES English-speaking families, enrolled in a Spanish Dual Language Immersion program since kindergarten. EF was collected using the Dimensional Change Card Sort task on the NIH Toolkit. English and Spanish receptive vocabulary were collected using the Peabody Picture Vocabulary Test. Decoding and reading comprehension was collected with the letter-word identification and passage comprehension subtests of the Woodcock-Johnson Test in both languages. Results show that on average, bilinguals had higher English vocabulary than Spanish, but their Spanish skills were equivalent to age-matched peers. On average, bilinguals' Spanish word reading was higher than their English word reading. Correlational results show that EF was significantly associated with receptive and expressive English vocabulary, but not with Spanish. These findings give a better understanding of higher SES bilinguals' language, literacy and EF skills, disentangling the effects of SES and bilingualism.

Acheiving California's Climate Goals: A Comparison Between California Policy Options and Swedish Greenhouse Gas Emissions Reduction Policy

Michael Yoakam
Sponsor: Susan Handy, Ph.D.
Environmental Science & Policy

Under SB 32, California seeks to reduce its greenhouse gas emissions to 40% below the 1990 levels by 2030. It is clear that California will need to implement further emissions reduction policies to reach this ambitious goal. My research seeks to study both how California has reduced its greenhouse gas emissions thus far as well as the overlap and differences between what policies academics indicate will be successful in California and what policies have historically been successful in Sweden. This paper will compare emissions-reduction policies between different influential sectors such as transportation, agriculture, electrical generation, etc., as well as between different levels of government. By undertaking a narrative review of notable emissions-reduction research and comparing that research to practices abroad, my research will shed some light on both the cultural and institutional differences that influence emissions-reduction policy as well as what tried-and-true methods California might consider employing to reach its climate goals.

Implications of Bilateral Asymmetry in Chickens' Tibiae and Humeri

Micaela Yoon
Sponsor: Maja Makagon-Stuart, Ph.D.
Animal Science

Just as humans may be right-handed or left-handed, animals may preferentially use one side of their bodies. This sidedness could result in asymmetrical development of bilateral bones. For practical reasons, measurements of bone strength and bone quality are usually obtained from either the left or the right bone. This practice, however, does not take into account the potential impacts of sidedness. The objective of this study is to determine the degree of symmetry in bones collected from the right and left side of Dekalb pullets in order to evaluate whether taking measurements from only one side of the body may impact study results. We collected the left and right humeri and tibiae from a total of 180, 8-week old Dekalb pullets. All bones will be scanned using dual-energy x-ray absorptiometry. Bone mineral density (a measure of bone strength), bone volume and bone area will be measured from the scans. Correlation plots and paired t-tests will be used to compare measurements obtained from each left and right bone. Differences in measurements obtained between the left and right side of each bird would indicate asymmetry, which should be taken into account in future research protocols.

Robotic Pets and Reminiscence Therapy in the Treatment of Dementia

Claire Young
Sponsor: Lisa Miller, Ph.D.
Human Ecology

As the proportion of older adults in the global population grows, the prevalence of Dementia and other age-related neurodegenerative disorders will become more prominent. A lack of stimulation will compound this issue, as it can accelerate the symptoms of these diseases and engender loneliness, costing the healthcare system millions of dollars. To address this growing problem within the older demographic, a robotic pet—which can act as a tool for reminiscence therapy, stimulation, and comfort—should be developed; it will provide companionship to the older adult, in addition to stimulating cognitive abilities through recital and synthesis of memories. Research into pet therapy, robotic pets, and reminiscence therapy led to the development of this model. The "RoboPet" will prompt the older adult to tell stories and memories to it, encouraging them to delve into their past and stimulate relevant areas in the brain; this can also revive fond memories, bringing joy to the older adult.

The Use of Pedigree Analysis for the Study of Color Blindness in Non-human Primates

Laura Young
Sponsor: Sara Thomasy, D.V.M.,Ph.D.
VM: Surg/Rad Science

Color blindness is a congenital, untreatable condition characterized by a malfunction in the cone photoreceptors of the retina. Genetic factors have been linked with this condition in both humans and non-human primates (NHP). Due to the structural and physiological similarities of the retina between both species, NHP are considered valuable models for the study of retinal conditions in humans. Our laboratory diagnosed four rhesus macaques with color blindness at the Northern California Primate Research Center, and a pedigree analysis combined with next generation sequencing was conducted to deduce a causative mutation for this condition. First, information regarding relatedness between macaques was collected, and a pedigree was built to detect the nature of the relationships between affected individuals. DNA was extracted from blood samples, and its sequencing revealed that all four affected individuals were homozygous for a variation of the Phosphodiesterase 6C (PDE6C) gene, crucial for color vision. The pedigree confirmed an autosomal recessive inheritance pattern for this condition, and identified heterozygous macaques as carriers. This poster highlights the advantages of using a pedigree to study the pattern of inheritance and determine the causative mutation of a condition, as well as its usefulness to find affected individuals and carriers.

Parent Acculturation and Children's Oral Proficiency: A Study with Head Start DLL Preschoolers

Hallie Yu
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Past research has shown that the levels of immigrant parent acculturation (PA) affect their adolescents' academic success and motivation. Research has focused on adolescents from Mexcian-American families. To expand on this topic with younger children and dual language learners (DLLs) from other backgrounds, we recruited DLLs from low-income immigrant families who were enrolled in Head Start centers in Northern California. A total of 27 DLLs from Mexican-American and 81 DLLs from Chinese-American families were assessed on the Picture Vocabulary, Oral Comprehension, and Understanding Directions subtests on the Woodcock-Johnson Tests. PA was collected with the Parent Cultural Social Acculturation, Parent Family Ethnic Socialization Skill, and Parent Ethnic Identity Scales. Results reveal that there were many similarities between the two groups on PA and DLLs' bilingual proficiency. However, Mexican-American parents had higher heritage language identity and heritage language media usage than Chinese-American parents. Correlation results show that parent's self-perceived English proficiency and parental English media usage were correlated with DLLs' English oral proficiency. These results suggest that the PA levels and the bilingual proficiency of Mexican-American and Chinese-American preschoolers are more similar than different and that there may be an association between PA and DLLs' English proficiency.

Executive Function and Bilingualism: A Study with Young Dual Language Learners in Head Start

Xuying Yu
Sponsor: Yuuko Tonkovich, Ed.D.
Education

Previous studies on children ages 8-11 years old revealed mixed findings on the associations between executive function (EF) and bilingualism. Few studies have been conducted with younger children and with DLLs from different language backgrounds. This study examines the association between EF and bilingualism in 52 Mexican-American and 95 Chinese-American preschoolers enrolled in Head Start centers in Northern California. EF was measured with the Flanker task on the NIH Toolkit and the Head-Toes-Knees-Shoulders test. Children's bilingual proficiency was measured with the Picture Vocabulary, Oral Comprehension, and Understanding Direction subtests of the Woodcock-Johnson Test. Results show no significant difference between the two groups on bilingual proficiency and on the EF tasks. Cluster analysis with home language and English vocabulary resulted in four groups: children with high proficiency in both languages (HI-HI); children with low proficiency in both (LO-LO), English dominant (ENG) and home-language dominant (HL). Examination of the clusters on EF shows that LO-LO scored significantly higher than ENG on the Flanker task and that HI-HI scored significantly higher than ENG on the Head-Toes-Knees-Shoulders task. Results suggest associations between EF and bilingualism may vary by measure and the type of EF.

US-China Trade Relations

Jenny Yu
Sponsor: Jaime Jackson, Ph.D.
Political Science

Since the signing of the US-China Relations Act of 2000 during the Clinton administration, trade between China and the US has quickly grown to over $600 billion in 2017. However, the US deficit with China has also grown rapidly alongside the growth of trade; as of December 2019, the US had a $48.9 billion deficit with China. This imbalance is attributed to China's unequal trade rights with the US, including weak enforcement of intellectual property rights and state interventions that heavily favor state-owned enterprises. In this brief, I make recommendations for future US-China trade policies. Most recently, the US and China were embroiled in a trade war which ended in a temporary truce. Although China has agreed to purchase an additional $200 billion of American goods and promised to better enforce intellectual property protections, the trade agreement maintains most tariffs and only lasts for two years. Drawing from previous US policies and the UK's interactions with China and connecting them with an understanding of Chinese culture and history, I suggest a combination of diplomatic means and economic sanctions in order to balance trade between the US and China.

Strategizing IDH1 Mutation with Novel Therapies for Long-term Regression of Cancer

Mehdia Zaidi
Sponsor: James Angelastro, Ph.D.
VM: Molecular Bio Sciences

The most frequent and aggressive brain cancer in humans is Glioblastoma Multiforme (GBM). The prognosis of GBM is typically 14.5 months with treatment, and this form of cancer lacks a cure, mainly due to the relapse of the tumors. This situation prompts the necessity for novel therapies due to its demonstrated resistance to radio/chemotherapies. IDH1/2 mutations are linked to the prognosis of secondary GBMs and low-grade astrocytomas through pervasive changes in histone and DNA methylation. Significantly, the IDH 1 mutant produces the oncometabolite, 2-hydroxyglutarate, which competitively inhibits normal alpha-ketoglutarate-dependent enzymes. This results in hypermethylation of CpG islands, a condition called Glioma CpG Island Methylation Phenotype (G-CIMP). Also, the IDH1 mutant sensitizes GBM cells to therapies. We investigated the related cell-permeable Octyl-(R)-2-hydroxyglutarate (Octyl-(R)-2HG), which has been shown to cause increased sensitivity to therapies in glioma cell lines. In order to develop combinational therapies, we targeted activation transcription factor 5 (ATF5), which is upregulated in many cancers, by employing our cell-penetrating dominant-negative ATF5 peptide in combination with Octyl-(R)-2HG to determine concerted loss of cell viability for GBM in at least two cell lines.

Poster Art: A Comparison Study of the Impact of Political Art in Past and Present Chicanx Movements

Emma Zamora
Sponsor: Maceo Montoya, M.F.A.
Chicano Studies

This study examines literature related to past Chicanx political movements and the central role art played in illustrating and furthering their causes while building solidarity and a sense of community identity. Using relevant literature and interviews, it analyzes Malaquias Montoya's poster artwork for Centro Legal de la Raza around immigrants' rights, as well as his work for the Third World Liberation Front Strike in counteracting Eurocentric education and helping to create ethnic studies departments at various universities. Topics explored include investigation of whether similar political posters are still being created for Chicanx movements, such as immigration policies, immigrants' rights, and Deferred Action for Childhood Arrivals (DACA), and examination of their purpose and efficacy today in comparison to the past. It also explores the impact of digital and social media as mediums for political protest art and how these mediums affect modern Chicanx political movements' ability to raise awareness, mobilize support, and build community identity.

PHOSP_RV, Human LYRM2 Gene, and Pig LYRM2 Gene's Effect on Mammalian Mitochondria Complex I Activity

Maria Zaragoza
Sponsor: James Letts, Ph.D.
Molecular & Cellular Bio

As some of you have probably heard many, many times the mitochondria are the "powerhouse" of the cell. What makes it such a powerhouse is the electron transport chain, also known as the respiratory chain, located in its inner membrane where ATP is generated. The first of the complexes and the first major entry point for electrons that make up this electron transport chain is complex I. Deficiency in complex I is one of the most common types of mitochondrial diseases. The overall goal in the experiment is to measure NADH activity in Complex I in the presence of LYRM2 human gene, LYRM2 pig gene, and rabies virus phosphoprotein p (PHOSP_RABVR) genes using purified mammalian mitochondria. We want to investigate the interaction between the LYRM2 human gene, LYRM2 pig gene, and PHOSP_RABVR gene and mammalian mitochondria complex I in vitro. These genes may activate complex I during its transition state to help stabilize it and lower the activation energy needed for enzyme turnover. If we find that is indeed the case, then we would want to solve the structure of complex I bound to the genes to analyze where these genes specifically bind.

Plastic Free Oceans: Addressing Single Use Plastic Consumption in Davis Restaurants

Alexis Zavala
Sponsor: Andrea Schreier, Ph.D.
Animal Science

The presence of plastic waste in the oceans poses a major threat to marine ecosystems. Numerous marine organisms become entangled in or unintentionally ingest plastic debris. Much of the population is unaware of the consequences of single-use plastics. This project aims to investigate single use plastic consumption in local restaurants in Downtown Davis. We surveyed local restaurants about the single-use products they offer to their customers. We distinguished which restaurants use eco-friendly products, determined how they heard about them, and evaluated the effects they have had on their business. We intend to examine the correlations between education programs, both of employees and customers, with the desire for an adoption of eco-friendly alternatives. We will quantify these impacts by investigating how much plastic can be diverted by making small changes at a local level. We aim to build a local model of community driven change that can be applied to other cities to address this global problem at a larger scale.

Infant Spatial Development in Puzzle Play

Ximeng Zhang
Sponsor: Lisa Oakes, Ph.D.
Psychology

Spatial abilities are important for effectively interacting with and perceiving objects in the world. One context in which we can see developmental change in young children's spatial abilities is during their puzzle play. Solving puzzles requires that children mentally and physically manipulating pieces to fit them into specific openings of a puzzle. We observed how children between 24 and 48 months (N = 70) insert a piece in a puzzle. Children were shown a puzzle with three empty differently shaped openings and one puzzle piece that fits in one of the openings. An experimenter pointed to each of the three openings and asked children which they thought the piece should go. Children were required to point to the openings that matched the puzzle piece. Then children were given the puzzle piece and asked to put the item in the appropriate spot. Although children overwhelmingly pointed to the correct spot, there was more variability in where they tried to insert the actual piece. By examining how long it took children to point to an opening, and how long it took them to insert the piece in the correct spot, we will have a better understanding of their developing understanding of spatial relations.

Roles of Siblings on Spanish-English and Chinese-English Preschoolers' Bilingual Skills

Yinuo Zhang
Sponsor: Yuuko Tonkovich, Ph.D.
Education

Previous studies have shown mixed findings on the role of siblings on bilingual children's language proficiency. Older siblings help younger children to understand their home language while other studies show that older siblings reduce the amount of home language. To further investigate the role of siblings on the bilingual proficiency of dual language learners (DLLs), 104 immigrant families (32 Mexican-American, 72 Chinese-American) were recruited from Head Start centers in Northern California. A total of 14 Spanish-English and 13 Chinese-English DLL preschoolers had either older and/or younger siblings. Parents were interviewed on the preschoolers' language usage and activities for each hour during a typical week. Preschoolers were tested on the Picture Vocabulary, Oral Comprehension, and Understanding Direction subtests of the Woodcock-Johnson Test. Results suggest that on average both Spanish-English and Chinese-English preschoolers spent more time playing electronics together than doing other activities. Furthermore, correlation and regression analyses show that more hours spent with siblings was associated with smaller English Picture Vocabulary scores, but higher scores on the Understanding Direction task in DLLs' home language. The findings suggest that interactions with siblings may assist in developing DLLs' receptive home language skills during the preschool years.

Attentional Control Uses Both Relational and Optimal Target Representations to Guide Search

Zhuojun Zhang
Sponsor: Joy Geng, Ph.D.
Psychology

Theories of attention frequently refer to the collection of target features in working or long-term memory as the "target template".Recent studies have found that the target templates are shifted to increase target-to-distractor distinctiveness. The relational approach hypothesizes that the target feature is encoded relative to the distractors (Becker, 2010).A stimulus that matches the relative attribute of the target is expected to automatically capture attention. In contrast, the optimal gain theory suggests that attention is tuned to a shifted target feature that increases distinctiveness from predictable distractors. This theory predicts attention will be captured most by the optimal off-target feature. The current study examined eye movements in a color visual search task with different types of irrelevant critical distractors to test whether attentional capture (first fixation) and attentional decisions (fixation dwell time) are better predicted by the relational or optimal theories. Moreover,we periodically tested memory probe for the target color using color wheel. The results demonstrated the initial capture of attention (and the first eye-movement) followed the relational theory, but fixation dwell times and the memory probe were better described by the optimal gain theory. The results suggest that multiple target representations subserve attentional control during different stages of visual search.

Development of a Hydrogel Bioreactor for Cost-Effective Extraction of BChE from Transgenic Rice Cells

Yuqian Zhao
Sponsor: Marc Facciotti, Ph.D.
Biomedical Engineering

The global bioprinting market is expected to reach over 4.1 billion USD in value by 2026. This explosion of the bioprinting industry includes using techniques like encapsulation of cells in alginate-based hydrogels. These hydrogels can be used as bioreactors for both cell growth and simplified protein extraction. Our team uses hydrogels with rice cells that were engineered to produce tetrameric BChE, a complex human serine hydrolase enzyme that provides protection against organophosphorus poisoning. This particular form of BChE has previously only been found in expired human blood plasma and costs over $10,000 to produce per treatment. By combining hydrogel encapsulation technology, a low-cost bioprinter, and transgenic rice cells, our group is working to develop a method of extraction that reduces the cost of producing this protein. To determine if hydrogel encapsulation is an effective way to extract BChE from transgenic rice cells, we ran repeated Ellman assays to quantify the levels of BChE present in solution over time. To determine if this would be a viable long-term solution to reduce extraction costs from the process of purification, we ran TTC cell viability assays to determine how prolonged exposure to gel affects cell growth and viability.

Wearable Posture Support for Surgeons

Mengya Zhao
Sponsor: Gozde Goncu Berk, Ph.D.
Department Of Design

Many medical workers including surgeons develop pain due to standing with poor posture. Lower back, neck and shoulders are the primary body parts affected by muscle fatigue. Our goal is to design a product that supports surgeons' backs while they are performing surgery for hours continuously. We conducted in-depth user research by interviewing eight surgeons about their needs regarding posture and pain during long operations. Our findings show that a potential wearable solution has to be sterilizable, comfortable, and unobtrusive enough to not interfere with surgeons' operations. To meet these constraints, we are developing a wearable product that provides muscular and skeletal support to alleviate pain using innovative materials such as shape memory alloys, polymers, and rapid fabrication techniques such as SLA 3D printing and lazer metal 3D printing. We hope that the product will eventually impact fields beyond medicine, supporting many different individuals with bad posture and back pain.

Assessing the ovipositional repellency of DEET and methyl salicylate on *Culex quinquefasciatus*

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Sponsor: Walter Leal, Ph.D.
Molecular & Cellular Bio

The southern house mosquito, Culex quinquefasciatus, is a vector of the West Nile and other encephalitis-causing viruses. Our lab has deorphanized an odorant receptor from Cx. quinquefasciatus, CquiOR32, which can generate inward (regular) and outward (inhibitory) currents when expressed in the Xenopus oocyte recording system. For example, methyl salicylate elicited inward currents, whereas DEET generated outward currents. DEET is a widely used mosquito repellent. Previously, our laboratory found that DEET as a spatial repellent is detected by CquiOR136. Both methyl salicylate and DEET have been shown to be spatial repellents. Here, we tested whether they could be oviposition deterrents. Oviposition assays are used to determine the egg-laying preference for a substrate. I will report on our findings leading to the conclusion that even at low concentrations both DEET and methyl salicylate are oviposition deterrents. When given a choice, gravid Cx. quinquefasciatus preferred to oviposit in clean water rather than in water containing either DEET or methyl salicylate.

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Domain Fluctuations in Ferroelectric Thin Films Using X-ray Photon Correlation Spectroscopy

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Materials Science&engineering

Complex oxides such as ferroelectric perovskites possess interesting functional properties such as thermodynamically stable polarization that can be controlled using an electric field. In ferroelectric thin films nanoscale domains of alternating polarization directions can form to minimize electrostatic and elastic strain energy. These domains can undergo fluctuations, depending on the applied temperature and misfit strain conditions, and can play an important role in determining functional properties in ferroelectric based devices. In this study, we investigated domain fluctuations in low-strain barium titanate ($BaTiO_3$) thin films using x-ray photon correlation spectroscopy (XPCS) at beamline 8-ID-E at the Advanced Photon Source at Argonne National Laboratory. The measured sample was a BTO thin film in capacitor geometry deposited on strontium titanate ($SrTiO_3$) substrate with a $SrRuO_3$ seed layer. We studied domain fluctuations across the second order phase transition where a/b domains transform to a/c domain structure, as well as across the first order phase transition where a ferroelectric to paraelectric transformation occurs at Curie temperature. Our findings show that fluctuations occur faster near the domain transformation temperature compared to near the Curie temperature, potentially due to structural changes (tetragonal to cubic) associated with the paraelectric to ferroelectric transformation.

Techniques for Inexpensive and Accessible Microfluidic Chip Manufacturing

Princeton Zhong
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Biomedical Engineering

RNA-sequencing allows for single celled transcriptional profiling. In an effort to make RNA-sequencing more accessible at a low cost, our team built a quick, reliable, and affordable microfluidics droplet controller. The device utilizes chips with engraved channels to direct droplet flow. Droplet microfluidics relies on high resolution channels to produce droplets capable of encapsulating individual cells. To improve the ability of the chips to consistently create droplets, 3-D printing and low-cost photolithography methods were assessed for their ability to create high resolution channels. To validate both the performance of the device and the capability of each fabrication technique, molds for an encapsulation chip were manufactured at various scales, which were then used to create droplets. Chip production methods were assessed on the following criteria: ease of production, manufacturing time, and ability to produce uniform droplets. Our team aims to produce protocols for both methods of microfluidic chip making. Since both methods are less expensive than the traditional chip making procedure, these protocols should provide value to any lab aiming to inexpensively employ microfluidics. When finished, our team hopes that our work will provide greater access to microfluidics and single-celled transcriptomics for researchers both on and off campus.

Improving the Time and Cost-Efficiency of the Tobacco Mosaic Virus ELISA

Manxia Zhu
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Biomedical Engineering

The enzyme-linked immunosorbent assay (ELISA) has been one of the most widely used plant pathogen detection methods since its invention in the early 1970s. The method involves using an antibody to immobilize an antigen and a second enzyme-conjugated antibody to detect the virus colorimetrically. Although popular, because it gives the opportunity for quantitative and accurate diagnosis, the ELISA can be a time-consuming assay, often taking lab technicians two days to get a diagnosis. In that time, a virus can quickly spread, potentially ruining a crop destined for seed stock. The aim of this project is to reduce the time and person-hours needed to perform an ELISA for tobacco mosaic virus (TMV). We are exploring the influence of changes to numerous experimental parameters on the sensitivity, cost, and time associated with the assay. For example, in early experiments, we explored different modes of mixing and sample incubation on the efficiency of the binding between the coating antibodies and the sample. Early results show that incorporating shaking at 125 rpm into the sample incubation step will reduce the amount of time needed to perform an ELISA while maintaining the expected sensitivity of the assay.

The Development of Infants' Attention to Social and Linguistic Cues

Yier Zhu
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Psychology

Humans learn to interpret the world around them by using social cues and interacting with others. At a young age, infants can follow eye-gaze cues (i.e., looking at the same object as their caregivers) and spoken-language cues (i.e., looking at an object when they hear a word) during social interactions. However, caregivers do not always look at the item they are referring to, which can create a confusing learning situation. Our research examines developmental changes in how infants integrate eye-gaze and spoken-language cues for driving attention. In our experiment, infants between 12 and 24 months watch a recording of two familiar objects (e.g. book on the left, cup on the right). In one condition, a speaker's face appears on the screen and says the name of one of the items while she looks at the item she is naming. In another condition, the speaker names an object but looks at the opposite object. We predict that younger infants will prioritize eye-gaze cues, whereas older infants will prioritize spoken-language cues when interpreting the social and linguistic information. We also predict that conflicting information will cause reduced word recognition. Our preliminary data support these predictions.

Zinc and Antioxidant Status Following Excess Iron Supplementation of Newborn Rats

Xianyu Zhu
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Nutrition

Iron supplementation or iron-enriched formulas are often recommended to prevent iron deficiency in infants. However, studies show that high iron exposure to infants can also result in adverse effects, such as mineral interactions, oxidative stress, illness, and altered cognitive development. Therefore, the objective of this study is to evaluate how increasing doses of supplemental iron affects the distribution of iron and zinc in the brain and other organs during the early postnatal period. To accomplish this, we supplemented newborn Lewis rats with vehicle control (10% sucrose), or 10, 30, or 90 mg Fe/kg body weight as ferrous sulfate beginning postnatal day (PD) 2 until PD 10. Iron and zinc were quantified in the brain, liver, duodenum, spleen, and kidney using atomic absorption spectrometry and histology. Lipid peroxidation and expression of antioxidant genes will also be assessed to evaluate which tissues are affected by oxidative stress following iron dosing. Currently, our results show that zinc concentration significantly increased only in the liver of all iron-supplemented groups. With further findings, we aim to provide insight as to which developing organs are most affected by excess oral iron exposure, and whether the developmental effects of excess iron can be attributed to zinc interactions.

Using Animal Models to Learn About Neurodevelopmental and Psychiatric Disorders – Some Experimental Approaches

Jiyuan Zhu
Sponsor: Alexander Nord, Ph.D.
MED: Psychiatry & Behav Sci

Due to the relative phylogenetic closeness and physiological similarities between mice and humans, genetic and environmental mouse models provide an opportunity to identify molecular pathways that initiate disease processes and lead to neuropathology in the offspring. In our lab, we use genomic approaches to investigate the molecular pathways underlying pathology. Particularly, we are interested in understanding what are the molecular mechanisms that trigger neuropathology. Here, I showcase some of our experimental approaches to characterize mouse models relevant to Neurodevelopmental and Psychiatric disorders, focusing on the initial steps of the molecular and phenotypic characterization in the lab, from genotyping to transcriptomic and neuroanatomical analyses. Using a couple of the mouse models we study in our lab, I give examples of embryonic and postnatal brain analyses we can perform based on the specific biological questions we need to answer, including techniques like PCR for genotyping, RNA preparation for RNA-seq analysis and Transcardial Perfusion and Immunohistochemistry for Neuroanatomy. Specifically, I mostly focus on how we used biochemical techniques to validate genomic and transcriptomic data at protein levels. Altogether, I provide evidence of how, from these sets of experiments, we can draw conclusions about molecular mechanisms underlying human neurodevelopmental and psychiatric disorders.

Heightened Respiratory Sinus Arrhythmia as a Function of Freezing Behavior in Preschool-Aged Children

Xinyu Zou
Sponsor: Paul Hastings, Ph.D.
Psychology

Dysregulated fear (DF) involves demonstrating high fearfulness in low-threat situations and is a risk for social anxiety (Buss et al., 2018). During fear, adaptive cardiac control involves parasympathetic decreases, as indexed by lower respiratory sinus arrhythmia (RSA; a parasympathetic measure). Paradoxically, studies find children with DF respond to threat with increased RSA, perhaps because they freeze in fear (Buss et al., 2018). Fear responses can include "fight-or-flight" or "freezing." Whereas the fight-or-flight response indicates heightened sympathetic activity, freezing reflects increased parasympathetic activity in animal models (Roelofs, 2016), suggesting that heightened RSA in DF children may result from freezing (Buss et al., 2018). This study investigates differences in RSA reactivity as a function of freezing behavior. We hypothesize that children who freeze will display higher RSA than children who do not freeze. Preschool-aged children (N = 182, M_{age}=4.91, SD_{age}=.99) participated in an examiner accident simulation task (EAS), a task wherein the examiner feigns an injury in front of the child to observe children's behavioral and parasympathetic responses. We coded children's fear and freezing behaviors from videos (?=.91) which will be used to test for associations with RSA. The results will help extend knowledge in understanding biological underpinnings for social anxiety.