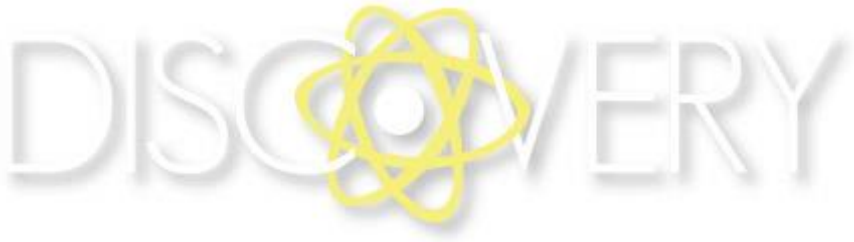
CalPolyPomona
College of Science



17th Annual
College of Science Research Symposium

Friday, April 26, 2024
12 – 2 p.m.
University Quad
(in front of Building 8)

2024 College of Science Research Symposium

BIOLOGICAL SCIENCES

1. **USING STABLE ISOTOPE ECOLOGY TO EXAMINE WATER USE EFFICIENCIES OF NATIVE PLANTS** Adam Sanders, Monica Uriaz, Ethan Esparza, Ava Santos-Volpe, Calvin Kamimura, Marlem Lopez-Meza, Advisor: Ehren Moler

   RESCUE-Net (Research Experiences in Southern California for Undergraduate Ecologists Network) is a multi-institutional network of southern California ecologists who are passionate about engaging undergraduate students in authentic research experiences. Our team of six undergraduate RESCUE-Net researchers have learned about stable isotope ecology and have focused our efforts on exploring ecological aspects of plants native to southern California during a year-long mentored multi-site undergraduate research experience.

   California has over 6,000 endemic plant species, many of which are adapted to drought and provide important resources for animals. To better understand the functioning of Southern California native plants in human-dominated landscapes, we designed and implemented an experiment that addressed three hypotheses using carbon and nitrogen isotope fractionation: (1) Urbanization reduces water use efficiency of native southern California plants; (2) Different plants have different water use efficiencies; and (3) Urbanization influences plant nitrogen sources and mutualistic relationships, specifically with mycorrhizae.

   We addressed these hypotheses through standardized sampling of south-facing foliage for multiple native plant species (Heteromeles arbutifolia, Salvia apiana, Salvia meliferia, Quercus agrifolia, and others) in urban and adjacent natural areas near six College campuses and exploring C and N fractionation which provide insights into plant water use efficiency (amount of carbon assimilated per unit water used), and possible presence of mutualistic relationships between plants and mycorrhizal fungus. Our findings provide valuable insights into improving water use efficiency and ecological function in urban settings.

2. **The Development of a High-Throughput Screening Method for STIV1 Viral Mutants** Addyson E. Hebbert, Advisor: Jamie Snyder

   STIV1 is a virus that infects the hyperthermophile Sulfolobous solfataricus. During the process of viral infection, the C92 protein of STIV1 accumulates at the cellular membrane and results in seven-sided pyramid structures. As the infection cycle concludes, the pyramid structures open thereby allowing the progeny viruses to be released into the environment. Our current hypothesis is that the pyramid structures form through oligomerization of the C-terminal end of the C92 protein. In order to test this hypothesis, viral mutants have been created and assayed. However, our screening methods proved to be time and labor intensive. To reduce the amount of time necessary in screening viral

mutants, we are testing the feasibility of other screening methods that are higher throughput. We are testing screening methods using the yeast-two-hybrid (Y2H) and split-ubiquitin systems. Both methods rely on protein-protein interactions and are performed in E. coli and yeast; and therefore, will result in faster screening time of viral mutants. Our hypothesis will be tested by creating C92 mutants and screening those mutants via the Y2H or split-ubiquitin systems. Thus far, we have tested wild-type C92 using Y2H and did not detect protein-protein interaction. The C92 protein contains an N-terminal transmembrane domain that anchors in the cell membrane during pyramid formation. At this point, we do not know if the Y2H screen was unsuccessful because C92 is a membrane-associated protein or whether our hypothesis is incorrect. Currently, two alternate approaches are being investigated. First, we will test C92 interaction using the split-ubiquitin system, which is better designed for membrane associated proteins. Another approach is to remove the N-terminal transmembrane domain from the C92 protein and screen using the Y2H system. By removing the N-terminal transmembrane domain, the Y2H system should then be feasible to screen mutations in the C-terminal end of C92. Not only will these experiments help elucidate a novel lysis mechanism used in archaeal viruses but will also result in a more time efficient mechanism for screening viral mutations.

3. **Microbial Diversity in Robert B. Diemer Plant Water Samples**
Aidan Barnett, Alina Der Bedrossian, Advisor: Sydnie K. Chase

The Robert B. Diemer Water Treatment Plant is a municipal facility currently sourced exclusively from the Colorado River and operated by the Metropolitan Water District. It serves the water needs of the greater Orange County Area. Having retrieved plant influent and solid reclamation supernatant water samples, we aim to characterize the microbial communities in each sample.
The 16S rRNA gene were PCR amplified from each environmental source, cloned into the TOPO-TA vector, and transformed into E. coli for subsequent Sanger sequencing. In visualization of the products via agarose gel electrophoresis, EcoPlate composition, and colony morphology, certain microbial species appeared most prevalent. Based on the Sanger sequencing results in the influent sample, various Gemmata species and F. tundricola appeared prominently. Whereas the reclamation supernatant displayed high identities of Plantomycetota and Sphaerotilus sp. bacterium. Further studies can identify the microbial communities when the influent water source changes to state water, for example.

4. **Role of Sex and CB2R in Systematic Candida albicans Infections in Mice**
Alexander Royas, Diego Henriquez, Advisor: Nancy Buckley

Candida albicans (C. albicans) is a yeast found in normal flora of most individuals. C. albicans is an opportunistic pathogen that can lead to mucocutaneous and systemic yeast infections in immunocompromised individuals. Systematic Candidiasis is responsible for about a 40% mortality. In our laboratory, it has been found that male mice are more

susceptible to systemic C. albicans infections compared to females as assessed by decreased survival and weight loss. While tissue fungal load is similar in male and female mice, blood serum IL-6 levels are higher in males compared to females. The immune response to systematic Candidiasis includes IL-6 production from APCs. IL-6 is then involved in activating neutrophil recruitment. Neutrophils are known to express the peripheral cannabinoid receptor (CB2R), a receptor involved in neutrophil homeostasis. The objective of this project was to investigate the role of sex and CB2R on systemic C. albicans infections in mice. Thus, male and female mice with (CB2R+/+) and without (CB2R-/-) the CB2R gene were infected intravenously with 7.5x105 C. albicans/20g and monitored daily for weight and visual health until collection of organs either 1, 2, or 3 days after infection. Tissue fungal load was assessed by counting C. albicans colony forming units (CFU), and tissue homogenate supernatants were assessed for IL-6 levels using enzyme linked immunosorbent assay (ELISA). We found that based on percentage change in weight in Figure 1, M+/+ had the most significant loss from day 0 and M-/- having the least change at 2 of the 3 days than other conditions. Fungal load was similar with all conditions on each day, with slightly lower fungal load for males on day 3 for both spleens and livers based on figures 2a and 2b. The spleens collected in Figure 3a show a lower IL-6 level in M-/- on day one but stays similar to most of the other conditions, however M-/- on day 3 is at a higher level than the other conditions. In Figure 2b, IL-6 levels in livers were similar with F-/- on day 2, as well as M-/- being at slightly higher levels. It seems that males not expressing the CB2R gene had lower fungal growth in livers and spleens on day 3, as well as had continuous neutrophil recruitment with IL-6 levels on day 3 in the liver. In the future a longer experiment of days 4 and/or 5 will be used to see if fungal infection and IL-6 levels will increase or decrease for each condition.

5. **Accumulation of β-amyloid protein in Angelman syndrome mice model**
Amir Ali Zavar, Advisor: Dr. Baudry

•Alzheimer's disease (AD) is a neurodegenerative disorder primarily affecting the brain's memory and cognitive functions. It typically begins with the accumulation of β-amyloid (Aβ) plaques in the brain, which disrupts cell function and leads to the death of neurons. This accumulation is associated with synaptic dysfunction, particularly in areas crucial for memory, such as the entorhinal cortex and hippocampus. Research indicates that an increase in soluble oligomeric Aβ is one of the key events that trigger synaptic dysfunction. One important finding is that Aβ oligomers cause a reduction in the activity of the protein ubiquitin-protein ligase E3A (Ube3A). Normally, Ube3A helps regulate synaptic connections by tagging damaged proteins for degradation, but in Alzheimer's, Aβ oligomers increase Ube3A phosphorylation, making it insoluble and unable to perform its function, leading to synaptic decline and cognitive deficits. Ref 1

•Angelman Syndrome (AS) is a neurodevelopmental disorder marked by severe learning difficulties, speech impairment, and distinct behavioral traits such as frequent laughter and excitability. Like Alzheimer's, AS involves a critical reduction in Ube3A activity; however, in AS, this reduction is due to genetic abnormalities that inhibit the expression

of the Ube3A gene. The lack of functional Ube3A protein in AS leads to abnormalities in the development and function of neural connections, similar to the synaptic impairments seen in Alzheimer's disease.ref

6. **Understanding the Genetic Underpinnings of Complex Flowers of Delphinium**
Ana Alcaraz Echeveste, Mankirat K. Pandher, Rakesh Kaundal, Advisor: Bharti Sharma

Most information on the genetic networks underlying floral organ identity establishment is from studies conducted on species within the core eudicots or in grasses, primarily on model systems such as Arabidopsis thaliana and Oryza sativa. While this information provides a great foundation to understand the genetic pathways broadly, it is imperative to dig deeper and sample across angiosperm phylogeny to understand the genetic underpinnings of complex floral organs. To this end, we use Delphinium X "Bellamosum," a basal eudicot, a member of the Ranunculaceae family, as our model system. The zygomorphic flowers of are composed of two distinct types of sepals and two types of petals. Sepals and petals with spurs and without spurs. The intricacies of these flowers are further exhibited by the paired dorsal petal spurs, which collectively grow into the outer sepal spur's pocket. The unique floral architecture of Delphinium makes it an interesting model system for evolutionary, genetic, and developmental studies. The aims of our study are 1) To understand the development, cell type, and expansion of perianth organs using light and Scanning Electron Micrography. 2) Use RNA-sequencing to understand the gene expression dynamics of sepals and petals. The comprehensive developmental analysis results for aim one show strikingly distinct cell types in the perianth organs. The evolution of such a complexity might be associated with pollination syndrome. For aim two, the extraction of RNA from sampled floral organs was standardized, and RNA libraries for 6-9 biological replicates were sequenced. We generated a reference transcriptome. The differential gene analysis being conducted on floral organs will identify the potential candidate genes underlying the complex floral organ identity of Delphinium.

7. **Comparisons of Halgerda Species**
Andres Camacho-Juarez, Advisor: Ángel Valdés

The genus, Halgerda, is part of the Discodorididae family in the Indo-Pacific region. It is recognized as the most diverse genus of the nudibranch family and many studies have been done to revise their classification, expand molecular data, and explore their diversity over the years. Although the use of molecular analyses in recent studies has led to a better understanding of the genus, there are cryptic/unexplored species from the Indo-Pacific region that have yet to be described. This study will be centered on analyzing undescribed species of Halgerda, where specimens collected from New Caledonia, will be utilized for comparisons. The goal is to provide a full description of the undescribed Halgerda species from my specimens of New Caledonia by distinguishing between each member and I will be comparing each specimen morphologically and genetically via DNA

sequences. I hypothesize that there will be differences between my specimens, as well as new species to the genus.

8. **Effects of Echinacea Based Feed Supplement on Erythropoietin and Hematological Markers in the Horse**
Anita Fereidooni, Samantha Mejia, Ivanna Marroquin, Ericka Diaz, Advisor: Juanita Jellyman

In 1989 the term “Nutraceutical” was coined by the blending of two words: “nutrient” and “pharmaceutical”. In both the human and animal world, a “nutrient” is defined as a substance that provides nourishment essential for growth and the maintenance of life, while a “pharmaceutical” is defined as relating to medicinal drugs or a compound manufactured for use as a medicinal drug.

Nutraceutical products are popular in the equine industry for the intent of treatment, control or prevention of various diseases (e.g. joints, laminitis). However, the use of nutraceutical as performance enhancer (ergogenic aid) is more commonly used than treatment for a disease. Much of the data used to promote equine nutraceuticals to the public comes from human research. There are a limited number of sound scientific nutraceuticals research studies conducted in the horse providing their efficiency or lack of efficiency. Scientific references on the use of Echinacea spp in the equine industry is limited and has been reported to be used for enhancing a healthy immune system and increase hematological parameters. The purpose of the study is to determine if a commercially available Echinacea based equine ergogenic supplement product (EPO-Equine) will increase circulating erythropoietin, packed cell volume, number of red blood cells, and hemoglobin concentration in the cardiovascular system of the resting horses.

9. **The role of reactive oxygen species (ROS) in controlling acute Toxoplasma gondii infection**
Anthony Temm, Advisor: Tatiane Lima

Toxoplasma gondii is an intracellular protozoan parasite that causes toxoplasmosis, a neglected parasitic disease in the United States. Neutrophils are among the first innate immune cells to respond to this infection. These cells possess several antimicrobial mechanisms, including the production of reactive oxygen species (ROS). Although ROS has been observed in T. gondii-infected neutrophils, the molecular mechanisms associated with this response and its effectiveness in killing T. gondii parasites have not been investigated. In neutrophils, ROS is produced primarily by the NADPH oxidase 2 (NOX2), comprised of five subunits, with gp91phox and p22phox making up the catalytic core unit

on the cellular membrane. The other three cytosolic subunits are p40phox, p47phox, and p67phox, which, when activated, act as regulators of NOX2. Here, we differentiated the promyelocytic cell line HL-60 into neutrophil-like cells (NLCs) and tested if two T. gondii clonal lineages (type I RH and type II PA7) could induce ROS production in NLCs. For that, NLCs were infected at a multiplicity of infection (MOI) 2 or 4, and total ROS was measured over time by luminol. Although type 2 T. gondii quickly induced high levels of ROS, type 1 T. gondii did not, suggesting a possible mechanism of immune evasion that will be further investigated. Additionally, we tested the expression and activation of NOX2 in T. gondii-infected neutrophils by Western blot. Our preliminary data showed constant gp91phox protein expression in neutrophils infected with either type 1 or 2 T. gondii strains. Interestingly, p40phox phosphorylation was observed only in type 2 T. gondii infections, suggesting that T. gondii-induced ROS production is mediated by NOX2 in neutrophils. Future experiments will confirm NADPH oxidase activation by testing other components of this enzyme. Additionally, we aim to characterize which cellular events may lead to ROS production and how effective these molecules are in killing T. gondii parasites.

10. **Examining the role of degranulation in neutrophil trogocytic killing of Trichomonas vaginalis**
    Arielle Angel, Advisor: Francis Mercer

    Neutrophil exocytosis of toxic granules (degranulation) is one method used to kill invading microorganisms. It may have a role in the contact-dependent killing of a protozoan parasite known as Trichomonas vaginalis. T. vaginalis is the causative agent of trichomoniasis, the third most common sexually transmitted infection in the United States. Neutrophils can kill T. vaginalis, but the mechanism is still poorly understood. Neutrophils cannot survive more than a day, but a progenitor cell line, HL-60, has been shown to be an effective alternative to neutrophils in vitro assays. These HL-60 cells can be differentiated into neutrophil-like cells (NLCs) and then stimulated to degranulate. The gene RAB27A is associated with the release of neutrophil's toxic granules. By knocking out RAB27A using CRISPR Cas 9, we expect these cells to no longer degranulate. Knockout of RAB27A can be confirmed by sequencing, detecting exocytosis of primary granules, and measuring myeloperoxidase (MPO) secretion. Primary granule exocytosis can be detected with the upregulation of a marker found on the surface of primary granules called, CD63. We will use these RAB27A knockout cells to determine if the exocytosis of neutrophils assists in killing T. vaginalis. Similarly, Nexinhib20, a small molecule, can inhibit the Rab27a – JFC1 binding and impair neutrophil exocytosis. We plan to incubate Nexinhib20 with primary neutrophils and investigate if degranulation is inhibited. Therefore, with these two approaches, we will be able to determine if neutrophil exocytosis assists in the killing of T. vaginalis and further our knowledge of the mechanism of the killing of neutrophils by this protozoan parasite.

11. **Understanding the mechanism of Daple-PDGFRB Gene Fusion in Leukemia**
    Arnel Ibarra, Advisor: Jason Ear

Gene fusion between the scaffolding protein Daple and cell-surface receptor PDGFRB have been identified in several patients with leukemia. Patients with Daple-PDGFRB gene fusion are responsive to tyrosine kinase inhibitors, suggesting that the kinase domain on the receptor is active. How the Daple-PDGFRB gene fusion is activated and affects leukemia cells is poorly understood. It is hypothesized that the PDGFRB kinase domains found in gene fusion remain constitutively active, leading to hyperactivation of cell-signaling downstream of receptor tyrosine kinases (RTKs). To test this, identified Daple-PDGFRB mutants found in patients were ectopically expressed in cells and kinase activation were determined using a phospho-specific antibody. We demonstrated that indeed, the kinase domain on the gene fusion were active, and partake in rampant cell signaling. Because drug resistance is common in cancers such as leukemia, the implications from this work may uncover additional methods of therapeutic interventions for patients harboring these types of mutations.

12. Identifying subpopulations of dopaminergic neurons essential for food anticipatory activity in mice

Jason Lee, Audrey Paik, Sara Rearick, Dillon Patwell, Natali Girgis, Amir Zavar, Advisor: Andrew Steele

Circadian rhythms are biological processes that run on 24-hour cycles; examples include sleep/wake cycles, body temperature regulation, hormonal release, and appetite. Circadian rhythms can be entrained by zeitgebers, which are external cues such as light, food, or environmental conditions. Dopamine (DA) signaling plays a key role in reward behavior and in particular, genetic studies have implicated dopamine signaling as a positive regulator of food anticipatory activity (FAA). FAA is the short period of activity prior to meal time: activities that are measured are walking, hanging, rearing, and jumping. During typical food entrainment studies mice are given 60% of their daily food intake at the same time daily. Using video recording software, our lab records mice and utilizes software to automatically track the movements of the mice and quantitate FAA. FAA is a behavioral adaptation observed in many organisms, but is mostly studied in mice, which allows genetic approaches to circuit level dissections of this behavior. It is characterized by increased levels of locomotor behavior preceding scheduled mealtime and is regulated independently of the suprachiasmatic nucleus, which functions as a pacemaker for controlling the timing of light-entrained circadian rhythms. We are utilizing conditional genetics to determine which subtype of dopamine neuron promotes FAA by deleting the rate-limiting enzyme for catecholamine synthesis, tyrosine hydroxylase, using different Cre recombinase driver lines, including neuronal-nitric oxide synthase, gastrin releasing peptide, Calbindin1, neuromedin-S, and glucagon-Cre. Preliminary results suggest that Calbindin1 and nNOS subtypes are crucial for promoting FAA in mice, whereas GRP subtypes are not, and NMS and GCG have yet to be examined.

13. Establishing Neutrophil-like-Cell Cultures to Investigate Cannabinoid Effects on Cell Functions

Bhavin Patel, Diego Henriquez, Advisor: Nancy Buckley

Neutrophils are important innate immune cells that help the body fight off pathogens. Neutrophils tend to be difficult to study in vitro due to being short-lived. PLB-985 and HL-60 are myeloblast cells that come from patients with acute myeloid leukemia. These cells can be differentiated into neutrophil-like cells (NLCs). NLCs can serve as a model to test neutrophil functions in vitro. Neutrophils express diverse types of receptors including cannabinoid receptors (CBRs) which recognize cannabinoids. However, the role of CBRs and cannabinoids on neutrophil function remains largely understudied. The objective of this work is to develop an NLC model to investigate the role of CBRs and the effect of cannabinoids. Thus, PLB-985 and HL-60s were grown in R-20 media (RPMI + 20% HI FBS + 1% pen-strep) until a cell density of 2x106 cells/mL was achieved. The cells were then diluted to 0.5x106 cells/mL and serum starved (RPMI + 0.1% FBS + 0.01% pen-strep) for 16-24h. Cell concentration was then adjusted to 3x105 cells/mL and placed in differentiation media (20% FBS + RPMI + 1% pen-strep + 1.3% DMSO) for 3 and 6 days. Another group of cells that were not serum starved were incubated in differentiation media also for 3-6 days. Cell differentiation was assessed via flow cytometry. CD11b+ cells are NLCs. Serum-starved cells that were differentiated for 6 days showed higher Cd11b expression in PLB-985 (88.50%). The HL-60 serum-starved cells expressed similar levels of CD11b as those found in the cells not serum starved after 3 or 6 days of differentiation. Thus far no conclusion can be made as to which of the two cell lines would be a better model in which to investigate cannabinoid effects. Further tests on neutrophilic functions like chemotaxis and NETosis, can better suit which cell line is best.

14. Genome Sequence and Analysis of Gracilibacillus halotolerans DSM 11805^T Isolated from the Surface Mud of the Great Salt Lake

Bianca Barbosa, Jasmine Tejeda, Rekha Seshandri, Advisor: Wei-Jen Lin

Gracilibacillus halotolerans DSM 11805^T is a gram-positive, motile, and halotolerant bacterium strain that has a genome size of 3.4 Mb, and GC content of 36.5%. G. halotolerans DSM 11805^T was first isolated from a mud sample in the Great Salt Lake in Utah, and can grow in high and low-salinity environments, optimal temperature being 47℃. This genome was sequenced by Illumina NovaSeq, Illumina was able to generate 9,840,722 reads. The final draft of the genome had 62 contigs in 58 scaffolds, with a mapped coverage of 440.2X. The Phylogenetic analysis using TYGS showed that the closest relative on the tree appears to be the species Gracilibacillus alcaliphilus DSM 10298, the closest relative of a different genus is Amphibacillus xylanus NBRC 15112^T. Functional analysis using JGI IMG showed multiple Quorum Sensing Pathways and genes including the Spo0A gene which is a key regulator for sporulation, as well as genes that

may be potentially involved in salt tolerance. The genome will be further explored to find correlation to its phenotype.

15. **The Effect of Chaga Mushroom on GAPDH Expression and it's Activity in HNSCC**
Brianna Fernandez, Advisor: Zohra Tumur

Head and neck squamous cell carcinoma (HNSCC) is the sixth most common form of cancer worldwide. It is an aggressive form of cancer that is often diagnosed at more advanced stages. This emphasizes a need to further understand the mechanisms underlying HNSCC progression. Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) has numerous cellular functions beyond its key role in glycolysis. With the activity and expression of GAPDH often altered in cancer cells, recent studies have suggested its possible role in cancer progression due to its involvement in cell proliferation, migration, and invasion. Earlier studies in the lab showed that Chaga mushroom extract can inhibit cancer cell proliferation in a concentration dependent manner. The purpose of this study was to evaluate the effect of Chaga mushroom on GAPDH expression and its activity in HNSCC.

16. **Comparative Analysis and Identification of Microbial Species From Soil Samples of the Same Environment and Differing Conditions**
Caitlyn H. Wu, Montserrat Valdez, Advisor: Sydnie K. Chase

In the natural environment a multitude of microbial species and microorganisms can be found. Sycamore Park is thought to contain a unique set of microbial diversity. To investigate the extent of microbial diversity found in Sycamore Park, soil samples were collected for downstream methods in an attempt to characterize the microbial community. Samples were collected near a stream (Site 1) and under deciduous trees (Site 2). Since this sample site is a popular area for
wildlife and plants alike, it is hypothesized that many different species of microbes will be characterized. Culture methods, EcoPlate data, and molecular techniques were employed to obtain quantitative and qualitative data to demonstrate the diversity found at Sycamore Park. The Shannon Index (H') and Shannon Evenness (E) for Site 1 is 3.409682788 and 0.992922392, respectively. For Site 2, the H' is 3.406398635 and the E is 0.991966024. The data indicates Sycamore Park contains high abundance and diversity according to the Shannon Index (1.5-3.5)
and Shannon Evenness/SEI (0-1) scales.

17. **Canopy Coverage Effects on Leaf Structure for Toyon (Heteromeles arbutifolia) Growing in a Walnut Woodland**
Camille Sanshu, Advisor: Edward Bobich

Heteromeles arbutifolia (toyon) is a shrub that occurs in chaparral, coastal sage scrub, and woodland communities and has demonstrated plasticity in its leaf structure with canopy coverage. Toyon in oak woodlands in Northern California had a greater leaf area and a lower specific leaf mass (SLM) under the canopies of the trees than they did in the open. Locally, toyon is one of the most common native species in Southern California black walnut (Juglans californica) woodlands and was planted under the canopies of, at the drip lines of, and in the open areas between the canopies of walnuts for a restoration project in 2014 at the John T. Lyle Center for Regenerative Studies. Based on the previous study, I hypothesized that leaves on toyons under tree canopies should have a greater area, lower SLM, and less lignified tissue compared to leaves in the open and that leaves at the dripline should be intermediate for those variables. Because J. californica is fully deciduous and has relatively sparse canopies compared to most oaks, I also believed that the differences among the toyon leaves from the canopy and the open will not be as great as for toyon growing in oak woodlands. To test the hypotheses, leaves were collected from toyon growing in the three canopy conditions. Following collection, the leaf area, fresh mass, and dry mass were determined. SLM was determined by dividing the dry mass of the leaves by the leaf area. Cross sections of leaves were stained with phloroglucinol to determine which tissues were lignified. The results supported my hypotheses in that the leaves of the toyons collected from the open area had the smallest area, greatest SLM, and had more lignified tissue than leaves for plants under the canopies of walnuts; leaves of plants at the dripline were also intermediate between the other two locations. It is believed that leaf area is the most reliable indicator for determining which woodland area the leaf was collected, because it has the smallest standard deviation of the leaf measurements. It should also be noted that the differences for toyon leaves among the locations in the walnut woodland were not as great as those in the oak woodland in the previous study.

18. **Size class specific habitat use of juvenile Caribbean snappers in Bocas del Toro, Panama.**
Daniel Ramirez, Casey Pua, Abigail Flores, Advisor: Jeremy Claisse

Mutton and Schoolmaster snapper are amongst the most abundant species of snapper found in the Caribbean. Shallow bays and mangrove lagoons function as nursery habitats for juvenile snappers before migrating to patch and coral reefs as adults (<25 cm). The objective of this pilot study, conducted as part of the Spring 2024 BIO 4500/L Field Biology (Panama Tropical Marine Ecology), was to investigate ontogenetic shifts in habitat preference by different size classes of juvenile Mutton and Schoolmaster snapper. Considering adult snappers migrate out of shallow bays, larger sized juveniles are expected to be more frequent in the adjacent seagrass beds and areas that drop off into deeper depths whereas the smallest juveniles will show preference to mangrove habitats for predator protection. Three sites off the leeward side of Isla Colón, Bocas del Toro were selected based on the presence of mangrove and shallow bays. Juvenile snapper surveys were conducted in snorkel with a 30 meter transect line along mangroves, adjacent seagrass beds, and drop off (6-meter depth) habitats. Snappers were identified to species

and classified into three size classes based on the observations of two surveyors. The results found all three size classes of juvenile Schoolmaster snapper to prefer mangrove habitat over adjacent seagrass and drop off habitat. Even the largest juveniles (20-25 cm) were most frequently found in mangrove habitat suggesting Schoolmaster juveniles use the nursery habitat fully up to adulthood. Mutton snapper displayed similar habitat use patterns but used adjacent seagrass beds at similar frequency to mangrove habitats at the smallest size class (0-10 cm).

19. **Characterizing the activation of brain regions in a dopamine mutant that fails to entrain circadian activity to scheduled mealtime.**
David Banuelos, Dillon R. Patwell, Afnan H. Saley, Advisor: Andrew Steele

Food anticipatory activity (FAA) is characterized by an increase in activity and physiological changes prior to a regularly scheduled mealtime. FAA can be achieved through food entrainment of the mice and can be observed prior to mealtime in the form of activities like wheel running, food bin entry, jumping, rearing, or walking. Despite decades of hunting for the brain region responsible for FAA, there is no agreed upon food entrained oscillator (FEO). Here, attempted to find neural correlates of FAA using immediate early genes (IEGs) expression, such as c-Fos. The group of genes known as immediate early genes is rapidly activated in response to a particular stimuli, such as changes in the surrounding environment. These genes can be used to map the activation of specific brain regions in response to different stimuli or behaviors. Feeding under calorie restrictions was the stimuli that leads the expression of IEGs in our experiment. We utilized mice with a conditional deletion of tyrosine hydroxylase in Calbindin1 neurons (TH cKO), THFloxed knockout, and in wild-type control mice to isolate feeding patterns in the brain that correlate to FAA. Mice lacking TH in calbindin1 neurons and THFloxed knockouts have a marked impairment in FAA. The current results indicate activations in the hypothalamus (HY), amygdala, midbrain (MB), and cerebral cortex (CTX) for both wild type and TH cKO mice. A goal of ours is to identify brain regions where c-Fos activation markers show differences in the IEG signals pre-meal (-2.5 hours) and post-meal (+1 hours) time conditions in mice exhibiting FAA and those that lack FAA.

20. **Characterizing Turkey Vulture Migratory Behavior to Understand the Effects of Lead Exposure on Soaring Raptors**
David Landis, Advisor: Andrea Bonisoli Alquati

Turkey Vultures (Cathartes aura) are exposed to lead from fragmented ammunition in hunted carrion. Lead is a neurotoxic substance known to disrupt endocrine function and impair motor and cognitive skills. Lead exposure has been found to negatively affect raptor flight behavior. However, no study has yet considered how lead exposure may affect cognitive function or soaring flight, which is dependent on proficient harvesting of energy from the atmosphere. We hypothesize that lead exposure reduces Turkey Vulture

flight cognition and performance during flight. Specifically, we predict that higher blood lead concentrations will be associated with a decrease in speed, altitude, and distance traveled, while increasing perching frequency and the angle of deviation from the intended path of migration. We tagged, collected blood samples, and placed GPS trackers on three migrant Turkey Vultures. Preliminary analyses indicate that the bird with the highest blood lead concentration had ~30% lower flight speed compared to the two other migrants. To more specifically compare the effects of lead exposure on the different types of flight, we plan to categorize Turkey Vulture movement tracks into thermal soaring, orographic soaring, gliding flight, and perching. We are manually classifying a quarter of the tracking data, then training a machine learning algorithm to categorize the remaining points. Preliminary testing on our machine learning algorithm has shown our model has a classification accuracy of >80%. Future developments will include tagging additional birds, increasing the accuracy of our classification model, and determining the effects of lead exposure on flight behavior. We hope our study will contribute to understanding the behavioral effects of lead exposure on Turkey Vultures and promote additional regulatory actions.

21. Sea Slug Hypselodoris Species From The Sea To CPP

Diana Castillo, Advisor: Ángel Valdés

Theoretical poster research objectives:
How will the classification of new species integrate with the existing phylogenetic tree?
Will these species represent a previously unidentified taxonomic group?

22. Comparison of the Reference Culturing Method and an Antibody Base Rapid Test for the Detection of Listeria monocytogenes in Food

Diana Duenas Alejandre, Advisor: Wei-Jen Lin

Listeria monocytogenes causes listeriosis, a serious foodborne illness in humans. Listeria species are abundant in soil, vegetations, and intestines of some animals. The microorganism can withstand substantial environmental hardship and persist in the natural and built environment for an extended amount of time. In addition, Listeria species are able to reproduce at refrigeration temperature, posing a serious food safety concern especially for refrigerated ready-to-eat food products. Outbreaks of listeriosis have been associated with the ingestion of a variety of raw and processed foods. Listeria monocytogenes is one of the most costly foodborne pathogens owing to its frequent involvement in large outbreaks, product recalls, and hospitalizations. Current FDA and USDA guidelines require the absence of Listeria monocytogenes in ready-to-eat meats, poultry, and deli products, as well as the absence of Listeria species on the food contact surfaces and environment of food processing facilities. Therefore, a reliable and efficient food and environmental Listeria monitoring method is essential for the compliance of the current food safety guidelines, as well as the protection for consumer safety. The

reference methods by USDA and FDA involve multiple culturing steps which takes 4 days to obtain the result. In this study, a rapid 25-hr Listeria testing protocol was assessed using an improved rapid enrichment medium and the antibody-based lateral flow device using polyclonal antibodies targeting pathogen specific proteins for L. monocytogenes detection. The Alternative method is comparable to the reference method in liquid egg and cooked shrimp (Chi square <3.84).The Alternative method is not equivalent to the Reference method in Deli meat, Smoked and Non smoked salmon (Chi square >3.84).The rapid method developed should be able to help timely detection of L. monocytogenes to prevent foodborne illness and reduce recalls on foods.

23. Investigating the Effects of Sex and CB2R on Neutrophil and Monocyte Egression and Neutrophil Maturity in Mice during the Acute Phase of Systemic Candidiasis Infection
Diego Henriquez, Alexander Royas, Advisor: Nancy Buckley

Background:
Sepsis accounts for 300 out of every 100,000 hospitalizations and is one of the most expensive American healthcare problems annually. Sepsis is defined as a dysbiosis of the immune system in which elevated levels of proinflammatory cytokines IL-8, IL-6, IL-18, TNF-a, and anti-inflammatory cytokine IL-10 are followed by systematic organ failure and thrombosis. Of the various pathogens capable of causing the immune dysregulation associated with sepsis, Candida albicans has the highest non-MRSA mortality rate at ~40%. Due to difficulties associated with diagnosis of Candida-induced sepsis, it is important to understand the molecular mechanisms behind fungal-induced sepsis to ameliorate the high mortality of this disease.

Methods:
C57/BL6 Mice were intravenously injected with 7.5x105 C. albicans cells/20g mouse. Kidneys, blood, and bone marrow were collected 1, 2 & 3 days after the infection. Kidneys were analyzed for fungal load. Kidneys and blood were assessed for the acute proinflammatory cytokine IL-6. Kidneys were embedded in paraffin blocks for immunohistochemistry and stained with Periodic acid Schiff Solution to identify fungal hyphae and kidney structures. Kidneys were also stained with Ly6G conjugated Alexa fluor 488 to identify Ly6G+ immune cell subtypes. The bone marrow was pooled by sex (F, M) and genotype (+/+, -/-), and populations were isolated via flow cytometry monocytes (LY6G-/CD11b+), neutrophils (LY6G+/CD11b+) and neutrophil maturity (CD62L hi/low, CD16 hi/low and CXCR4). All flow data was analyzed using floreada.io, a free, open-source, online flow cytometry analysis software. All graphs and statistical analysis were done using Graph Pad Prism.

Results:
CB2R +/+ females were shown to lose more weight than their F -/- counterparts and M+/- males lost more weight than M-/- mice. CB2R -/- mice were approaching a red blood cell count (RBC) of ~30% regardless of sex and had a lower % RBC than CB2R +/+ (or CB2R+/-)

mice of the same sex. On days 1,2, and 3 Male CB2R +/+ mice had higher IL-6 levels than any other group at the same time point. Kidney PAS staining showed localization of Candida albicans at or near kidney glomeruli and a mass of immune cells encapsulating fungal hyphae within the kidney.
We see that Female CB2R +/+ mice have the highest numbers of neutrophils in the bone marrow at day 3 but there is no significant difference between any of the other groups. In the bone marrow, CB2R +/+ mice tend to have higher neutrophil levels than CB2R -/- mice of the same sex. In the blood, CB2R +/+ females again have the highest neutrophil levels and trend higher than their CB2R -/- counterparts. CB2R +/+ females have higher monocyte levels than CB2R -/- females and both male groups. In the blood, there is a CB2R-dependent drop of monocyte numbers visible in both sexes. Kidney slices were stained with Alexa fluor 488 conjugated Ly6G to identify Ly6G+ cells localizing in an infected kidney. This shows that there are elevated numbers of immune cells located in the kidney when compared to uninfected mice. More work is needed to compare groups. Males have higher levels of the CD16low and CD 62LHI immature neutrophil subset in the bone marrow and blood. In the blood, males have the lowest levels of mature neutrophils, and CB2R -/- males have lower levels of mature neutrophils than CB2R -/- males. In the blood, CXCR4 expression is highest in the CB2R +/+ males, and CB2R +/+ mice trend higher than the CB2R -/- mice of the same sex.

Conclusions:
There appears to be a strong sex effect in cytokine levels and in the production of more immature neutrophil subtypes. Particularly CD16LOW CD62LHI neutrophils, which are more prone to adhering to epithelial tissues and producing ROS. More work needs to be done to determine if CB2R alters egression of immune cells out of the bone marrow, but day 3 data points to this conclusion.

24. Probing Response Regulator Protein WalR as a Future Antibiotic Target by Alanine Scanning Mutagenesis

Diego Ponce, Myricca Clare Romero, Advisor: Hendrik Szurmant

Background: Antimicrobial resistance of pathogenic bacteria is considered among the most significant threats to human health. New antimicrobial targets must be explored to combat this threat. We hypothesize that the DNA-binding surface of bacterial response regulators might be a possible target.

Methods: We explored the DNA-binding surface of the essential response regulator WalR by alanine scanning mutagenesis. A genetic screen was developed where the wiltype copy of the walR gene could be inducible eliminated following the introduction of mutant walR alleles.

Results: Introduction of alanine mutations at positions R203 and R204, two DNA binding positions in WalR showed that position R204 is crucial to support viability, since the R204A

mutant did not produce colonies.

Conclusions: Based on existing protein-DNA structures, we can identify R204 as a crucial DNA-binding position. A previously constructed R204C mutation and the here derived R204A mutation are not viable. Thus, a compound targeting the DNA-binding interface surrounding the R204 residue should be lethal and of could serve as a novel antimicrobial.

25. Effect of maternal high fat diet consumption during pregnancy on hypothalamus-pituitary-adrenal gland axis of offspring.

Digisha Ahir, Metzli Gomez, Valerie Chou, Advisor: Juanita Jellyman

Consumption of a high fat diet (HFD) during pregnancy alters HPA axis function in the offspring of rodents. The current study determined the effect of maternal HFD on cortisol secretion in sheep offspring at 16 weeks of age. Pregnant ewes were assigned to control (n=3) and HFD (n=3) groups. The control group was fed pellets. The HFD group were fed pellets with 30% rumen protected fat (Megalac). After birth lambs were weaned at 12 weeks and given free access to control pellet diet with grains. To assess cortisol secretion at 16 weeks, lambs were infused i.v with adrenocorticotropic hormone (ACTH; 2 ug/kg). Blood samples (1 mL) were taken through the jugular catheter at −30, −15, and 0 min (before) and 5, 15, 30, 60, 90, and 120 min after ACTH for measurement of plasma cortisol by ELISA. Data were analyzed by two-way ANOVA. Basal plasma cortisol tended to be higher in HFD (32±8 ng/mL) than control (13±3 ng/mL) lambs, but this did not reach statistical significance. Plasma cortisol was higher than baseline from 15 to 90 minutes after ACTH administration in all lambs ($P<0.05$). The increment in plasma cortisol was higher in HFD than control lambs from 15-90 minutes ($P<0.05$). The maximum increase in plasma cortisol at 60 minutes and was higher in HFD (245±8 ng/mL) than control lambs (121±50 ng/mL $P<0.05$). These data suggest that maternal consumption of a high fat diet during pregnancy may increase basal and stimulated activity of the HPA axis in sheep.

26. The Effect of Sex and Mouse Strain in a Systemic C. albicans Infection.

Edgar O. Perez Valdes, Advisor: Nancy Buckley

The role of sex in immunological defenses against bacterial and viral infections are better understood than the defense against yeast infections such as those caused by Candida albicans (C. albicans). C. albicans is an opportunistic pathogen which poses varying risks depending on the individual's immune status. Our lab has found that, in mice from a C57BL/6 background, males with a systemic C. albicans infection are more susceptible to the infection than infected females, as evidenced by survival rates and weight loss. While tissue fungal load remains unaffected by sex, male mice have higher blood serum IL-6 levels than females. The objective of this project was to determine whether sex played a role on the susceptibility to the yeast infection in a different mouse strain. Mice on a

C57BL/6 background are inbred mice (mice with a homogenous population genome) while Swiss Webster (SW) mice are an outbred mouse strain (mice with a heterogeneous population genome). Thus, SW male and female mice, along with mice on a C57BL/6 background were infected with C. albicans (7.5x105 yeast cells/20g mouse). Survival rates, weight changes, tissue fungal load, and serum IL-6 levels were assessed. We found that SW mice were more susceptible to the yeast infection compared to mice with a C57BL/6 background as assessed by greater disease symptoms. In both mouse strains, males were more susceptible to the infection compared to female mice as assessed by survival, weight loss, disease scores and blood IL-6 levels, but not tissue fungal load. These data suggest that SW mice have a higher susceptibility to systemic C. albicans infections than mice on a C57BL/6 background. In addition, our data supports our previous findings where males are more susceptible to females to a C. albicans infection.

27. Optimizing immunity against toxoplasmosis by using exosomes released from T. gondii tachyzoites, bradyzoite cysts, and host immune cells

Eliana Moisa, Advisor: Tatiane Lima

Toxoplasma gondii is an apicomplexan parasite that infects a third of the global human population. Infection commonly occurs through ingestion of contaminated water or food. T. gondii acute infection is characterized by fast replicating tachyzoites that differentiate into bradyzoites as the infection transitions into chronic. During the progression of the disease, this opportunistic parasite makes its way to the brain and establishes a chronic infection as dormant bradyzoite cysts to live long-term until they are possibly disrupted in the setting of a compromised immune system. There are currently no viable vaccines for humans and therapeutic strategies have not evolved much since the 1950s and can lead to damaging side effects. Developing an ideal vaccine remains a significant challenge due to the complexities of the T. gondii life cycle, immune evasion strategies, and strain diversity. Previous studies have demonstrated the potential of exosomes released from T. gondii tachyzoites in immunization protocols that lead to partial protective immunity in mice. Exosomes are extracellular vesicles that carry essential cargo ranging from a variety of RNA, lipids, and bioactive proteins that play an essential role in the immune response and cell signaling. Although previous studies have shown that T. gondii exosomes induce partial immunity against toxoplasmosis, we aim to investigate if the use of combined exosomes secreted by tachyzoites, bradyzoites, and host immune cells could lead to a more effective and long-lasting protection. To test the potential of exosomes released from type II (PA7-GFP) T. gondii tachyzoites and bradyzoites in triggering immune responses and protection against toxoplasmosis, we will isolate these extracellular vesicles from both T. gondii life stages and tachyzoite-infected host immune cells and confirm their presence by evaluating the surface marker CD63, an exosome marker, and life stage-specific surface proteins (SAG-1 and CST-1) through Western blot and microscopy. After extracting exosomes from both life stages and infected host immune cells, we will then immunize C57BL/6 mice by injecting the exosomes intramuscularly 2 weeks prior to T. gondii infection. After infection, survival rates will be monitored over

time. Additionally, the levels of antibodies against T. gondii will be evaluated by ELISA, and the cellular immune responses will be evaluated by the analysis of cytokine levels. This study will expand our understanding of the therapeutic potential of T. gondii-secreted exosomes in providing immunity against toxoplasmosis.

28. Anticoagulant Rodenticides in Raptors in Southern California

Ella Eleopoulos, Advisor: Andrea Bonisoli Alquati

Anticoagulant rodenticides (ARs) are a group of environmental pollutants commonly used for pest control. Animals targeted by AR use are also prey of apex predators. These predators, including many raptors, face a high risk of secondary AR exposure due to the toxicant's bioaccumulative nature. Toxicity of ARs depends on the inhibition of vitamin K recycling, which reduces the body's ability to clot blood. The toxicological effects of ARs in exposed raptors include excessive bleeding, dull mentation, and anemia, which in turn may impair hunting ability, and increase susceptibility to disease and other toxicants. For this research we will collect blood, blood smears, and feathers from Red-shouldered Hawks (Buteo lineatus), Swainson's Hawks (Buteo swainsoni), Red-tailed Hawks (Buteo jamaicensis), and Great Horned Owls (Bubo virginianus). Capturing will take place in Kern, Inyo, Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego counties. To detect and quantify the amount of ARs in each blood sample, we will perform dispersive solid phase extraction followed by liquid chromatography and mass spectrometry (LC-MS). ARs in this study include warfarin, chlorophacinone, diphacinone, brodifacoum, bromadiolone, and difethialone. This study will quantify exposure to ARs and test for a positive correlation to indicators of stress, such as decreased hematocrit and increased heterophil lymphocyte (H/L) ratio, in the previously mentioned raptor species. We will also test for a positive relationship of ARs exposure between parent and nestling Red-tailed Hawks. Further, ArcGIS Pro will be used to spatially analyze sample locations to test for increased ARs exposure levels in Red-tailed Hawks due to nesting proximity to urbanized areas.

29. RedOx Stress Blockage of Oxidative Metabolism and How it Relates to Alzheimer's Disease

Emmanuel Lujano, Marylin Gastelum, Alan Hernandez, Advisor: Glenn Kageyama

Pathological stress found in cells resultant from deficiencies in the maintenance of reduction-oxidation (RedOx) reaction homeostasis is an emerging topic that could prove crucial to understanding how cortical neurons are lost in Alzheimer's neuropathology. In this project, we aim to tie together the effects of RedOx stress to the state of glucotoxicity from which it stems, as well as elucidate how such conditions might contribute to the development of Alzheimer's disease (AD). Failure to maintain RedOx homeostasis results in largely the same outcome, being the production of reactive oxygen species (ROS),

however, its causes are manifold, emanating from the activation of several different metabolic pathways that are alternative to the complete aerobic respiration cycle, all of which are inherently toxic to the cell via the ROS proliferation they engender. Non-Demented with Alzheimer's Neuropathology (NDAN) is a novel clinical finding which accounts for up to roughly thirty percent of Alzheimer's cases and is characterized by the lack of cognitive decline typically associated with AD, while retaining the hallmark signs for Alzheimer's: phosphorylated Tau (p-Tau), neurofibrillary tangles (NFTs), and beta-amyloid plaques (Aβ). The fact that such cases exist begs that we explore what specifically keeps NDAN brains from developing dementia and how we might promote cognitive function through lifestyle changes. This project explores RedOx stress as a contributor to the degree of neuronal degeneration and cortical degradation seen in AD cases, synthesizing the effects from a number of different processes already associated with glucotoxicity into a comprehensive and novel stressor that plays a significant role in finding a suitable biomarker for distinguishing between AD and NDAN cases. In the near future, we aim to implement a prepared experimental design to quantify the presence, or lack thereof, of RedOx stress in AD and NDAN brain samples and compare them against a control group of standard, undiseased, samples. We hope to show elevated levels of RedOx stress in AD samples, while displaying similar levels of RedOx stress in NDAN and standard samples.

30. The Importance of Pyruvate Dehydrogenase for Neuronal Survival

Fatima Lizette Martinez, Ayah Elsamad, Advisor: Glenn Kageyama

Hypoxia-inducible factor (HIF-1a and HIF2a) is necessary for the cell's capacity to adjust to deficiencies in oxygen levels (hypoxia). It is hypothesized that HIF-2a may be one of the factors leading to hypoxic adaptation of neurons for survival within non-demented individuals with high Alzheimer's Neuropathy (NDAN). The pyruvate dehydrogenase (PDC/PDH) multicomplex enzyme can be found in oxidative metabolism; catalyzing the reaction that interconverts pyruvate into acetyl-CoA. PDH consists of three complexes known as pyruvate dehydrogenase (E1), dihydro-lipoyl transacetylase (E2), and dihydro-lipoyl dehydrogenase (E3). This enzyme can be regulated via covalent modification, such as phosphorylation via pyruvate dehydrogenase kinase (PDK) of the E1 complex, leading to the inactivation of PDH. Studies have shown that under hypoxic conditions HIF-1a stimulates the increase in various proteins associated with glycolysis, including GLUT1 and 3 (glucose transport), glycolytic enzymes (HKII, PFK1, ALDOA, ENO1, PKM2 and LDHA), and PDK (inhibitor of PDH). In contrast, HIF2a activates PDH, by inhibiting PDK. The activation of PDH via HIF2a allows pyruvate to enter the TCA cycle via Acetyl-CoA to support multiple anabolic processes necessary for survival, including amino acid, nucleotide synthesis, antioxidant production, redox balance and ATP synthesis, all products of oxidative metabolism. Our lab has some preliminary evidence for the presence of elevated PDH levels in an important cognitive processing area (anterior cingulate cortex) of the brains of NDAN, but not AD individuals. Dr. Kageyama's research team intends to analyze PDH levels in the hippocampus, subiculum and entorhinal cortex using immunohistochemistry

(IHC) to establish concrete evidence that surviving neurons in NDAN can rely on oxidative metabolism for their survival.

31. **Characterization of novel adeno-associated viruses across varied genetic backgrounds in mice**
Fernando Garcia, Kalif Johnson, Advisor: Andrew Steele

Adeno associated viruses (AAVs) are viruses that are non-pathogenic and therefore can be used as vehicles for genetic cargo delivery, without causing significant damage to the organism. Naturally occurring AAVs are used to engineer variants through a process called directed evolution with the goal to target specific cell types, such as neurons and glial cells in the brain for gene therapy. To test the efficiency of variants “AAV9-CPP2 and AAV9-CPP3”, are engineered viruses that package the gene for GFP, a series of three genetically different inbred strains of mice (C57BL6/J, DBA/2, and BALB/cJ) were injected retro-orbitally. The mice were incubated for three weeks, and then euthanized, transcardially perfused, and fixed for the collection of the brain and liver. The brains and livers were then sectioned and stained using immunofluorescence to mark neurons and glia. GFP was used as a reporter gene to visualize successful viral delivery. A confocal microscope was then used to collect images for visualization and quantification. Through engineering, qualitative, and quantitative analysis we were able to characterize the expression patterns of AAV9-CPP2 and AAV9-CPP3, which revealed that this variant was not successful in infecting neuronal or glial cells.

32. **Microbial Community Analysis of CPP's Japanese Garden and Lyle Center Water Sources**
Gabby Ferraro, Samantha Hernandez, Advisor: Sydnie Chase

Microbial diversity can be found all around the world to varying degrees, some more diverse than others. Different features found in various environments can influence microbial diversity, even small differences in location, carbon sources, and pH. A comparative analysis of these minor differences effects has yet to be done on Cal Poly Pomona’s Lyle Center’s and the Japanese Garden’s microbial environments. By collecting environmental water samples from said sources we are able to visualize the distinct variations and similarities present in the microbial communities. With these samples, we cultured and utilized molecular techniques to analyze the differences and possible similarities between the two water sources. We expect to see differences in these water sources due to microbes being able to express high diversity in places that are close in range to each other but utilized by different organisms from animals to plants. Our results concluded that there were some significant levels of differences, however, due to these water sources being located close to each other, they share some similarities as a result.

33. The Gut and Anxiety and Depression

Gabrielle C. Atencio, Ariana N. Cavero, Advisor: Glenn Kageyama

The Gut-Brain axis refers to the bidirectional communication between the gut and the brain. This connects the enteric and central nervous systems, linking emotional and cognitive centers of the brain with peripheral intestinal functions. This review searched for studies concerning the gut microbiome and its relation to anxiety and depression. The Gut-Brain axis relationship was explored as well as the gut microbiome's influence on depression and anxiety. This study finds that there is a strong association between the gut microbiome and mental health.

34. Undiscovered Diversity of Tenellia Nudibranch Sea Slugs

Grant Srun, Advisor: Advisor: Ángel Valdés

New Caledonia is home to an astounding diversity of groups marine organisms such as nudibranch sea slugs. There are many species unique to this archipelago and many yet undescribed species that have been found there in recent years.

The genus Tenellia is one such group of nudibranchs that needs taxonomic resolution. This study will sample and genetically analyze more than 150 specimens from several islands of New Caledonia. The results of this study will help to gain a deeper insight into the marine biodiversity of the region and to better understand the ecological role that these marine invertebrates play in the coastal ecosystem. Genetic analysis will bring to light the evolutionary diversification and dispersal of these unique organisms.

35. Comparison of Sensitivity and Specificity Between Rapid Detection Methods of *Salmonella* Spp.

Gaudalupe Bernal, Wei-jen Lin, Advisor: Wei-Jen Lin

Salmonella is one of the leading causes of foodborne diseases in the Unites States and worldwide, so prompt detection of Salmonella in food is essential for food safety and public health. Rapid tests, including the PCR or antibody-based detection, are being developed within the past few years. The antibody-based lateral flow device is low cost, portable, and suitable for on-site testing at food processing facilities. Newly developed antibody-based device was compared to existing device for sensitivity by analyzing limit of detection. Specificity of the newly developed device was analyzed by an inclusivity and exclusivity studies. The newly developed device is comparable in sensitivities between the commercial device (SinglePath®) and the developing device (Decision Point), which supports the suitability of its use in detecting Salmonella. In addition, the possibility of using Nanopore sequencing for Salmonella identification is being explored.

36. Comparison of larger coastal California fish species based on their habitat, movement patterns, and reproductive biology/ The Potential Effects of Fish Movement and Habitat Use Patterns on Secondary Production

Hailey Blair, Ella Diamond, Advisor: Jeremy Claisse

Secondary fish production is the primary pathway of energy flow through an ecosystem as it produces energy for consumers, which includes humans. This type of production is driven by the transfer of organic material between trophic levels. It can be calculated by the total amount of new biomass resulting from growth for all individuals in a specific area during a unit of time (Claisse, 2014). This calculation incorporates population properties or processes which include body mass, reproduction, growth rate, and survivorship rate (Dolbeth, 2012). Therefore, this metric can be used to understand various marine habitats value by being an indication of health of the ecosystem, which may reflect other external factors such human caused environmental impacts, habitat quality, or other natural disturbances (Water, 1977). These marine habitats include (but not limited to) inland waters, natural coral reefs, reefs formed from oil platforms, estuaries, the sea floor. Secondary fish production can ultimately be used for many ecological and conservational purposes to understand marine habitat's function and efficiency. It represents the "success" rate of that specific environment for a given time. The factors contributing to this "success" can be observed and applied to conservational efforts in order to increase secondary fish production for other habitats. Understanding fish movement patterns and reproductive behaviors can be used to estimate how much of a species secondary production could attributed to a certain habitat depending on the proportion of the time they spend using that habitat. For this project we have focused on investigating what is known about the movement reproductive patterns of five local marine fish species: Stereolepis gigas (Giant Sea Bass), Mycteroperca xenarcha (Broomtail Grouper), Triakis semifasciata (Leopard Shark), Myliobatis californica (Bat Ray), and Galeorhinus galeus (School Shark).

37. Analyzing Soil Samples across the CPP Campus for Levels of Herbicide

Ian Perez, Advisor: Steve Alas

Analyzing the level of various herbicides used on the CPP campus via soil samples.

38. Characterization of an novel engineered adeno-associated viruses across varied genetic backgrounds in mice

Idalina Bonham, Arshia Bose, Advisor: Andrew Steele

Adeno associated viruses (AAVs) are viruses that are non-pathogenic and therefore can be used as vehicles for genetic cargo delivery, without causing significant damage to the organism. Naturally occurring AAVs are used to engineer variants through a process called directed evolution with the goal to target specific cell types, such as neurons and glial

cells, in the brain for gene therapy. To test the efficiency of variants “AAV9-CPP6 and AAV9-CPP8”, are engineered viruses that package the gene for GFP, a series of three genetically different inbred strains of mice (C57BL6/J, BALB/cJ, and DBA/2) were injected retro-orbitally. The mice were incubated for three weeks, and then euthanized, transcardially perfused, and fixed for the collection of the brain and liver. The brains and livers were then sectioned and stained using immunofluorescence to mark neurons and glia. GFP was used as a reporter gene to visualize successful viral delivery. A confocal microscope was then used to collect images for visualization and quantification. Through engineering, qualitative, and quantitative analysis we were able to characterize the expression patterns of AAV9-CPP6 and AAV9-CPP8, which revealed that this variant was not successful in infecting neuronal or glial cells.

39. Characterization of aquatic microbial communities within Cal Poly Pomona’s duck pond
Ignacio Morales, Advisor: Sydnie Chase

Cal Poly Pomona contains multiple aquatic ecosystems capable of supporting diverse microbiomes. The duck pond located on campus plays host to various species of fish, birds, and other eukaryotic organisms. However, limited information exists regarding the microbial species living within this zone. We obtained water samples from the duck pond, and used a combination of culturing techniques and DNA analysis/sequencing to determine the identity of microbial organisms within our samples. We successfully isolated a series of organisms from colony cultures. We gram stained three individuals: a gram positive cocci, gram negative rod, and a spore-forming rod. We identified two unique organisms: Viridiraptor invadens and Nitokra hibernica. V. invadens is a heterotrophic protist. N. hibernica is a microscopic crustacean. Our results suggest the existence of diverse microbial communities in Cal Poly Pomona’s aquatic environments.

40. Analysis of the Effects of Melatonin on Chemotherapy & Tumor Migration
Isabel Carbajal, Stephanie Rama, Advisor: Steve Alas

Each year, approximately 106,000 Americans are diagnosed with colon cancer and it is estimated that 1 in 24 people will be detected with colon cancer throughout their lifetime. Melatonin is a lipophilic hormone produced by the human body and it is involved in regulating intestinal reflexes, metabolism, protection against inflammation, sleep-wake cycles and other functions. It was found that patients with colon cancer can have up to 3147 pg melatonin per gram of colon tumor tissue, while non-cancer patients had 467pg/g. This made for a large difference between normal and malignant tissue. This project was conducted to examine whether melatonin affects colon cancer cells' ability to respond to chemotherapy. We also looked at whether melatonin influences the cells' ability to migrate, which contributes to tumor spreading. We found that higher levels of melatonin in colon cancer cells induced higher levels of cytotoxicity by cisplatin, a commonly used chemotherapeutic drug. We also observed that melatonin made

migration of colon cancer cells more aggressive after 24 and 48 hrs. These are preliminary results and need further investigation.

41. Investigating the role of the complement system against Trichomonas vaginalis

Isabel Veronica Romero, Advisor: Frances Mercer

Trichomonas vaginalis is a protozoan parasite that causes trichomoniasis, the third most common sexually transmitted infection in the United States. Trichomoniasis disproportionally affects woman causing discomfort, frothy white discharge and cervicitis if left untreated. The World Health Organization estimated 156 million new cases of Trichomonas vaginalis infections in 2020. However, despite its prevalence, it classified as a neglected disease. Once Trichomonas vaginalis infects its host, it must adhere onto the vaginal or prostate epithelium as it is too large to enter cells. Neutrophils are the first leukocyte to respond at the site of infection, making them the foot soldiers of the immune system. They utilize three modes of killing: degranulation, NETosis, and phagocytosis. However, neutrophil defense against Trichomonas vaginalis involves a novel mechanism known as trogocytosis, a process by which the neutrophil obtains material from the parasite's plasma membrane. The receptor-ligand interaction mediating trogocytosis is not characterized although, it has been discovered that neutrophils must be in the presence of human serum to successfully kill the parasite. Complement proteins and antibodies are abundantly found within serum and could be playing a role in trogocytosis. The complement system contributes to pathogen defense via opsonization or by initiating the MAC complex. However, pathogens have adapted mechanisms to avoid complement mediated killing. One way is by acquiring host complement inhibitory surface proteins called Regulators of Complement Activation (RCAs). It is unknown if Trichomonas vaginalis steals host RCAs to prevent complement mediated killing but we hypothesis that Trichomonas vaginalis can acquire RCAs from neutrophils' surface to avoid complement mediated killing. Complement opsonization of Trichomonas vaginalis is accomplished by complement protein iC3b, which is deposited onto the surface of the parasite. iC3b can facilitate the attachment of human neutrophils via complement receptor 1 (CR1), complement receptor 3 (CR3) or complement receptor 4 (CR4). We hypothesize that one or more of these complement receptors play a crucial role during the trogocytosis of Trichomonas vaginalis. Understanding the role of the complement system against Trichomonas vaginalis could provide more insight into the immune response during infection.

42. Effects of early-life exposure to exercise on phenotypic properties of mouse skeletal muscle

Isabella Barry, Advisor: Robert Talmadge

The impact of 10 weeks of voluntary early-life exercise on the phenotypic properties of mouse skeletal muscle were evaluated in this preliminary study. Three control (C) mice

were housed in individual cages with a locked running wheel. Two mice were kept in identical cages, but the running wheel was free and accessible to the mice (low resistance, LR). Three mice were housed in identical cages with free running wheels that included a 15% resistive load (high resistance, HR). Wheel revolutions were quantified. Mice were then euthanized and hindlimb muscles dissected, frozen and stored at -80 degrees Celsius for protein analyses. The muscles were analyzed for slow muscle fiber protein content (slow/cardiac troponin isoforms) to detect fast to slow muscle adaptation, as typically occurs with endurance training. On average, LR mice ran 79428, HR mice 50930, and C mice 0 revolutions/week. HR mice showed increases in troponin I slow protein content compared to. LR, and C. Interestingly, both HR and LR mice showed increases in troponin C cardiac and MyHC-I protein content compared to C. The elevations in troponin I slow and troponin C cardiac protein in HR and LR mice are indicative of a fast to slow muscle phenotype transition with exercise. Despite running less, the HR runners displayed greater adaptations in slow phenotypic protein content suggesting that resistive load is a critical factor in determining the extent of adaptation.

43. Identification of Unknown Microbial Organisms within a Soil Environment Using Molecular Techniques

Jadeanna Martinez, Linh Ta, Advisor: Sydnie K. Chase

The study of microbial communities within an environment that we are interested in studying could tell us the existence of diverse organisms and what they offer in that setting. They can offer an array of diversity which can be biological and biogeochemical factors. However, there is a limited number of microorganisms that have been found and identified as we try to understand the number of microorganisms that are present in the environment. issues such as non-culturable microbes and lack of understanding of the 16S rRNA sequence to characterize microbial communities are still underway. For this experiment, we have collected a soil sample from our Cal Poly Pomona Japanese Garden (environment) and performed further analyses such as culturable and molecular methods to better understand the microbial community we want to study. Our results after analyzing the rDNA sequences show that our sample was able to match with a microbial organism in the environment.

44. Analysis of Shiga Toxin Sequence Diversity in Shiga Toxin Producing E. coli Isolated from Food and Outbreaks

Jasmine Tejeda Michel, Advisor: Wei-Jen Lin

Shiga toxin producing E. coli (STEC) is one of the top three pathogens that causes foodborne outbreaks and product recalls. Each year more than 265,000 people become infected in the U.S, with more than 3,600 hospitalizations and 30 deaths. STEC is a Gram-negative bacterium that inhabits the intestines of healthy cattle. When contaminated food and/or water are consumed by humans it can be vile causing bloody diarrhea,

vomiting, and hemolytic uremic syndrome (HUS). HUS is a rare but dangerous condition characterized by renal hemolysis that can lead to kidney failure. STEC is the leading cause of HUS cases therefore as STEC outbreaks increase so will HUS. As such, STEC has become a public health concern, with many different serogroups affecting both developed and developing countries.

STEC produces highly cytotoxic shiga toxin (Stx), a class II ribosome-inactivating protein that cleaves specifically at 28S rRNA of the 60S ribosome subunit. This toxin is classified into two types, Stx1 and Stx2, while having several subtypes under each. They are different by toxin potency, host cell specificity, sequences, and size. It is commonly seen that Stx2 is more potent than Stx1 and has more severe symptoms, but the reasoning behind it is still unclear. It is also not fully studied how the toxin type, subtypes, and variations correlate to the severity and spread of outbreaks and the types of food involved. Our lab has a collection of 50 confirmed STEC strains isolated from known outbreaks and over 100 potential STEC isolated from food. We have purified and characterized over 100 STEC strains and the presence and absence of stx1 and/or stx2 in these isolates is being determined by PCR. Positive stx genes will be sequenced to compare sequence homology and variations to understand its correlation to outbreaks and food matrices. Our study will further our knowledge of stx sequence diversity and whether it has any correlation to disease outbreaks.

45. Wearable Sensors to Record Cattle Fly-Repelling Behavior

Jose Cabrera, Haley Mai, Advisor: Juanita Jellyman

Biting flies, including stable flies and horn flies, are pests that harm cattle when their painful, persistent bites cause blood loss, tissue damage, and allergic reactions. Cattle respond to bites through expression of numerous fly-repelling behaviors. These fly repelling behaviors include shaking of the head and ears, stamping of legs, flicking of the tail, and twitching of the cutaneous muscle just beneath the skin. Time and energy spent performing fly repelling behaviors can reduce animal growth and lower milk yield due to time lost feeding or resting. The objective of the study was to use on-animal sensors to detect fly-repelling behavior in cattle. Animals housed in the Cal Poly Pomona cattle unit that are seasonally exposed to horn flies and stable flies were used in the study. Three-axis accelerometer sensors were attached to an ear tag using velcro or were secured on the tail base, front ankle, back ankle, or the neck using vet wrap. Cattle fly-repelling behaviors were recorded using video cameras. In collaboration with UCR, our long-term goal is to develop a behavior dictionary for multiple fly repelling behaviors performed by cattle wearing sensors as part of a pest surveillance system to help producers make informed pest management decisions based on real-time data.

46. Studying the Effects of Genistein on the Saccharomyces cerevisiae Cell Cycle

Joseph Edward Alas, Jocelyn Cluff, Wendy J. Dixon, Karine Le Roch, Advisor: Wendy J. Dixon

One of the leading causes of morbidity and mortality in the world is cancer. The most frequently diagnosed cancer types worldwide are lung, breast, and colorectal cancer. While many chemotherapeutics and anticancer drugs have been developed, they do not work on all types of cancers and can have unwanted side effects. Therefore, studying alternative agents is important. Genistein, a phytoestrogen found in soybeans, is known to lower the risk of cancer in patients, though limited research has been done. In some in vitro cancer cells, genistein has been shown to induce apoptosis. It has also been shown to have an effect on cell cycle progression including arrest in cell cycle checkpoints. In other cancer cells, genistein has been shown to override the G1/S phase arrest and increase cell division. The goal of our research is to develop a model to identify at the molecular level the effects of Genistein on various cancer cells. In particular we use the yeast Saccharomyces cerevisiae with different genetic backgrounds to mimic some of the phenotypes observed in cancer cells. We also use hydroxyurea to induce cell cycle arrest and analyze the effect of genistein and its potential on overriding the G1/S phase arrest. Using microscopy technique and FACS analysis as well as proteomic and transcriptomic studies, we aim to identify all molecular pathways affected by genistein. Preliminary results indicate that genistein can only overrides the cell cycle arrest in S. cerevisiae overexpressing CDC7 (Cell Division Cycle 7) gene. Several experiments are ongoing to validate our results and identify additional proteins affected by genistein.

47. The biological diversity of the tropical sea slug genus Tambja (Mollusca: Gastropoda) in New Caledonia

Julian Alberto, Advisor: Ángel Valdés

Evidence from various marine organism groups suggests that the tropical western Pacific, particularly the Coral Triangle, boasts the highest marine species diversity, gradually decreasing outward. Despite several proposed hypotheses, consensus on the reasons behind this pattern remains elusive. Heterobranch sea slugs conform to this trend, with the Coral Triangle exhibiting the greatest diversity, though exceptions are rare and typically linked to adaptive radiations in colder regions. New Caledonia's sea slug fauna stands out as an exception, displaying unexpectedly high diversity levels comparable to the Coral Triangle, despite its distant location. Understanding the evolutionary processes behind this anomaly could provide crucial insights into marine speciation mechanisms; although obtaining basic species data in the area using contemporary techniques is a prerequisite for further investigation.

48. Glucotoxicity in Alzheimer's Disease

Juliette Arteaga, Connie Ngu, Emmanuel Lujano Emily East, Jacqueline Wilson, Sawyer Hardy Advisor: Glenn Kageyama

Due to recent studies in Alzheimer's Disease (AD) and Type II Diabetes (T2D), many researchers have questioned the mechanism of how neurons in the brain accumulate degeneration. Along with the downward effects of amyloid plaques phospho-tau, we believe glucotoxicity is another major cause of the death of neurons contributing to Alzheimer's. Glucotoxicity refers to the detrimental effects that prolonged exposure to high levels of glucose can have on certain cells that are responsible for producing insulin. This hormone is crucial for regulating blood sugar levels. With diabetic patients, hemoglobin A1C tests are presented to observe how much glucose sugar units have attached to the hemoglobin molecule which becomes glycated protein. Increased HbA1c levels tend to lead to oxidative stress, metabolic syndrome obesity, and all types of dementia. It has been observed that those with AD or any form of dementia also tend to have metabolic syndrome or conditions such as diabetes and hyperglycemia, all of which promotes high glucose-toxic oxidative stress linked to dementia. We are focusing on six major pathways in which glucotoxicity activates, causing damage to neurons including the Methylglyoxal, Sorbitol (Polyol), Enediol, Hexosamine, Protein Kinase C (PKC), and the Reductive Toxicity pathways.

49. Genome Sequence and Functional Analysis of Devosia enhydra Type Strain 9BT Isolated from Freshwater

Kaitlyn Moreno, Jonathan Hernandez, Joshua Joe, Diana Alejandre, Advisor: Wei-Jen Lin

Here, we report the high-quality, permanent draft genome sequence of the Devosia enhydra 9bT type strain, a mesophilic bacterium isolated from a freshwater creek overflow sample in Davis, California. The genome was sequenced by Illumina HiSeq 2000 platform generating 8,564,766 raw reads. After sequence read filtering, assembling, and gene annotation, the final draft genome has 5 scaffolds with 248x coverage. Devosia enhydra 9bT has a genome of 4.2 Mb with 4082 predicted genes and a high GC content of 65.63%. The whole-genome based phylogenetic analysis shows that the closest relative of Devosia enhydra is D. insulae, and Pelagibacterium lacus is the closest relative from a different genus. Initial functional pathway analysis shows various degradative pathways and fermentation of solvents such as ethanol, suggesting a potential role for Devosia enhydra's in sustainable bioremediation and as a biocatalyst for solvent production.

50. Measuring Aggression in Threespot Damselfish (Stegastes planifrons)

Priscilla Martinez, Rianna Hernandez-Thorn, Betty Wong, Kat Garcia, Jeremy Claisse, Ángel Valdés, Advisor: Jeremy Claisse

This project was conducted as part of spring 2024 BIO 4550/L Field Biology: Panama Tropical Marine Ecology and sought to investigate the aggressive behavior of the Threespot Damselfish (Stegastes planifrons), a small territorial herbivore. After initial observations, we were all intrigued by the highly aggressive behavior of the damselfish,

noting that they were lunging at investigators. We expected to see an increase in attacks with an increase in territory size. We also expected to see higher aggression in adults as compared to juveniles, since adults were more likely to demonstrate aggressive behavior as compared to younger juveniles. Threespot damselfish individuals were monitored via snorkeling in 5-minute intervals and both aggressive (attacks and lunges) and non-aggressive behavior (ignored) was documented. Abiotic conditions, such as habitat percent cover, area of defensive coverage, and depth were also recorded. Threespot damselfish grazing increased with territory size, most notably in adult damselfish. Aggression attacks decreased slightly as territory size increased for both adults and juveniles. With greater number of aggression attacks, there was less grazing by both adult and juvenile damselfish. This project gave us hands-on experience at investigating fish behavior, as well as using the scientific method directly in a new field, the Panamanian coral reefs. We learned how to take data in rain and in the hot sun, in turbulent and murky waters, and even learned that fish have distinct personalities just like humans do.

51. The phylogeny and diversity of Bat-winged Sea Slugs

Kathrina Belle Garcia, Advisor: Ángel Valdés

This research seeks to resolve phylogenetic relationships of Family Gastropteridae by determining same vs. different species by achieving the following main goals: 1.) Work with voucher specimen to assign cryptic species as a single, genetically distinct taxon, or a species complex. 2.) Identify morphological characteristics and sequence molecular data to decipher genetic boundaries.

52. Classification of Trapania species with Morphological & Molecular Analysis

Katrina Lam, Advisor: Ángel Valdés

Historically sea slug species were generally classified by their external morphological characteristics. In the species Trapania, they display variation of colors and patterns. Although in recent studies, analyzing molecular data has resulted in categorizing the species differently than in past studies. Molecular analysis has proven that morphology alone is unreliable in classifying sea slug species. The species of Trapania were collected from Koumac, New Caledonia in the Koumac 2.1, 2.2, and 2.3 expeditions (2018-2019). There was a total of 79 species that were collected with each specimen's DNA extracted and then amplified in PCR. Once the DNA was purified, samples were sent out for genetic sequencing. These samples were compared to GenBank's specimens from past studies. A phylogenetic tree was created with the recently collected samples along with the data in GenBank. This represents the evolutionary pathways and connections among the Trapania species. Current ongoing research is reinforcing the classification of existing Trapania species as well as identifying potentially unclassified specimens.

53. Characterization of a novel engineered adeno-associated viruses across varied genetic backgrounds in mice

Kelli Griggs, Irene Tran, Advisor: Andrew Steele

Adeno associated viruses (AAV) are viruses that are non-pathogenic and therefore can be used as vehicles for genetic cargo delivery, without causing significant damage to the organism. Naturally occurring AAVs are used to engineer variants through a process called directed evolution with the goal to target specific cell types, such as neurons and glial cells, in the brain for gene therapy. To test the efficiency of variants “AAV9-CPP5 and AAV9-CPP7”, are engineered viruses that package the gene for GFP, a series of three genetically different inbred strains of mice (C57BL6/J, BALB/cJ, and DBA/2) were injected retro-orbitally. The mice were incubated for three weeks, and then euthanized, transcardially perfused, and fixed for the collection of the brain and liver. The brains and livers were then sectioned and stained using immunofluorescence to mark neurons and glia. GFP was used as a reporter gene to visualize successful viral delivery. A confocal microscope was then used to collect images for visualization and quantification. Through engineering, qualitative, and quantitative analysis we were able to characterize the expression patterns of AAV9-CPP5 and AAV9-CPP7, which revealed that this variant was not successful in infecting neuronal or glial cells.

54. The Immunoregulatory Role of CMKLR1 Within the CNS During WNV Encephalitis

Keven Kwok, Advisor: Douglas Durrant

West Nile Virus (WNV)-induced neuroinvasive disease (WNND) has been a public health concern in North America since its introduction in 1999. In recent years, severe neurological illness has been reported much more frequently, together with neuromuscular manifestations. Previous studies have shown that dendritic cells (DCs) within the central nervous system (CNS) are required to restrict WNV replication and immunopathology by regulating anti-viral T-cell responses. In this study, we examined the role of CMKLR1 within the CNS during WNV encephalitis. CMKLR1-expressing microglial cells and CNS-infiltrating myeloid DCs have been shown to have an inflammatory role during autoimmune neurological disorders, yet their contribution to WNND remains unknown. In addition, chemerin, the ligand for CMKLR1, was upregulated in the CNS of WNV-infected mice. To evaluate the role of CMKLR1, we infected CMKLR1-deficient (CMKLR1-/-) and wild-type (WT) mice with WNV. WNV-infected CMKLR1-/- mice exhibited increased susceptibility to WNV, loss of virologic control, and more severe clinical signs of disease. Proinflammatory chemokine receptor expression, including CCR1, CCR5, and CXCR3, was significantly decreased in the absence of CMKLR1 suggesting reduced leukocyte trafficking into the CNS. For future studies, we will determine the numbers and type of infiltrating leukocytes and their role in virologic control within the WNV-infected CNS. Taken together, these data will help clarify the immunoregulatory role of CMKLR1 during WNV encephalitis.

55. Investigating the lysogenic cycle of STIV viruses

Kimberly Aguilar, Elisabeth Batres, Jamie Snyder, Advisor: Jamie Snyder

Viruses are the most abundant biological entities found in all domains of life. Archaeal viruses display similar characteristics to viruses found in the eukaryotic and bacterial domains. However, our knowledge of archaeal viruses is limited compared to our knowledge of viruses infecting the other two domains of life. Recent work on a particular virus group has resulted in the emergence of a model system for studying archaeal viruses. The Sulfolobus turreted icosahedral virus (STIV) family infect Sulfolobus species that inhabit acidic (pH 1- 4) hot springs (70-80°C) within Yellowstone National Park. STIV1 was the first member of this growing virus family. It was the first lytic virus isolated from Sulfolobus. Viruses can undergo two replication strategies: a lytic and a lysogenic cycle. In the lytic cycle, a virus will attach to the host cell, release its genetic material, hijack the host's machinery to replicate, assemble virions, and egress the host cell. In the lysogenic cycle, also known as latency, the virus integrates into the host's genome and persists in the host until the conditions are no longer favorable. Subsequently, as the cell replicates, the viral genome replicates as well; the viral DNA is passed onto progeny cells. Despite the abundance of archaeal viruses, little is known about viral integration. Integration of viral DNA is a form of site-specific recombination, but integrases can serve other functions. STIV1 engages in a lytic replication cycle but encodes an integrase-like protein (A510). However, there is no evidence demonstrating STIV1 integration into its host. With the recent discovery of an STIV variant that integrates, we decided to investigate the potential integrase protein in both STIV1 and STIV3. The overall goal of this project is to learn more about the lysogenic cycle in STIV viruses. In order to learn more about integration, viral mutants will be created in both STIV1 and STIV3. Virus replication and integration will be assayed using qPCR, western blots, and Southern blots. Three viral mutants have been generated and have yet to be transfected into the host. Understanding the role of A510 will provide further insight into virus evolution and replication.

56. Evaluating Second Generation Anti-HIV Universal CAR-NK Cells

Kristie Quintero, Advisor: Jianming Xie

Our laboratory has previously developed a universal chimeric antigen receptor (CAR) natural killer (NK) cell, which recognizes the chemical compound 2,4-dinitrophenyl (DNP) and
can subsequently be redirected to target various epitopes of HIV-1 enveloped glycoprotein 160 (gp160), using DNP-conjugated anti-gp160 antibodies as adaptors. This strategy can potentially
counter the highly diverse and mutable HIV1, providing a promising solution to eradicate HIV-infected cells, which express gp160 on their surfaces. However, the first-generation anti-DNP CAR was based on T cell signaling, which might not be optimal in NK cells. We hypothesize that second-generation universal CAR-NK cells using NK cell-specific signaling domains will be more potent. In this study, we tested our hypothesis
by replacing T cell signaling domains in the CAR with NK cell-specific signaling domains,

including NKG2D and 2B4. We then compared the efficacy of first- and second-generation anti-HIV universal CAR-NK cells by cell coculture assays, using gp160+ HEK293 cells as a mimic of HIV-infected cells and measuring NK cell production of IFN-gamma and cytotoxicity.

57. Adverse Childhood Experiences Among Incoming Cal Poly Pomona Students

Reuben Saldivar, Lauren Murkar, Isabel Altamirano, Lian Dial, Advisor: Juanita Jellyman

Adverse Childhood Experiences (ACEs) are stressful or adverse events occurring before the age of 18 and are linked to an increased risk of various health conditions, including depression, coronary heart disease, and stroke, potentially leading to premature mortality and diminished well-being. There are 10 types of ACEs. This study aimed to assess the prevalence of ACEs among a subpopulation of undergraduate students at Cal Poly Pomona (CPP). We distributed surveys via email, receiving responses from 1,478 students, of whom 512 qualified and completed the survey. Ten questions were included about the 10 types of childhood adversity (ACEs) and current mental health including 2 anxiety items ("Feeling nervous, anxious, or on edge" and "Not being able to stop or control worrying") and 2 depression items ("Little interest or pleasure in doing things" and "Feeling down, depressed, or hopeless.") The findings revealed a large frequency of ACEs among the participants, with the majority reporting at least one ACE. The actual prevalence of ACEs may be underestimated, as individuals might be reluctant to disclose sensitive information or may not recognize that they experienced verbal abuse or parental mental illness. Pearson correlations were run, and almost all 10 ACEs were associated with depression and anxiety. These results underscore the need for further information about the link between childhood stress and adult mental health issues such as anxiety and depression. Further analysis is needed to determine whether different demographic groups have experienced more ACEs and have higher rates of mental health issues (e.g., anxiety and depression).

58. Establishing a vulvovaginal candidiasis mouse model to investigate the effect of cannabinoids

Lauren Wong, Advisor: Nancy Buckley

Vulvovaginal candidiasis (VVC), commonly known as a vaginal yeast infection, is a fungal disease primarily caused by an overgrowth of Candida albicans (C. albicans). It is estimated that about 75% of women will experience a VVC infection at least once in their lifetime, with about 5% of women having recurrent VVC infections. Susceptibility to VVC greatly depends on factors such as sexual activity, immune status, and substance usage, which can include the use of marijuana. Delta-9-tetrahydrocannabinol (THC) is the primary psychotropic compound found in marijuana. THC can bind to cannabinoid receptors such as the peripheral cannabinoid receptor (CB2R) which is primarily found on immune cells. Thus, there is the potential for THC to alter the immune response during a VVC infection. Neutrophils are the primary innate immune cell known to fight VVC that

could potentially be affected by THC. The current study aimed to create a VVC mouse model for our lab to investigate the effects of THC. Thus, female mice were injected subcutaneously with estradiol in sesame oil (SO) three days prior to infection with 5 x 10^6 yeast cells/mL of C. albicans. Mice were then monitored daily and the vagina, vaginal lavage (VL), uterus, kidney, bone marrow (BM), and blood serum were collected 2-4 days after the infection. Vagina, uterus and kidney fungal loads were determined by counting C. albicans colony forming units (CFU). Tissue homogenate supernatants and blood serum were analyzed for IL-6 levels using enzyme linked immunosorbent assay (ELISA). VL and BM cells were analyzed via flow cytometry to assess neutrophil levels. Our data show that we have successfully developed a VVC model that we can now use to determine the effects of THC in the infection mouse model.

59. Field Experiment Evaluating the Effect of Damselfishes on the Feeding Patterns of Scarus iseri (Striped Parrotfish)

Abby Yuen, Maggie Dillon, Jordyn Scott, Cassie Bilecki, Advisor: Jeremy Claisse

Striped Parrotfish Scarus iseri are roving herbivores and can play a key role in coral reef community structure by eating turf algae and potentially creating space for new coral recruits on reefs. Many species of damselfish exhibit territorial behaviors and may impact parrotfish assemblages and shift benthic community structure by excluding herbivores from their territory. As part of the Spring 2024 BIO4550/L Field Biology (Panama Tropical Marine Ecology) class we conducted a three-day pilot study in Bocas Del Toro, Panama assessing the effect of damselfishes on initial phase Striped Parrotfish feeding behavior. Snorkel surveys were conducted at three different sites following individual parrotfish noting fish size, bite rate, substrate composition, presence of damselfishes, and attacks by damselfishes. Striped Parrotfish that had more than five attacks by damselfishes had relatively lower bite rates than Striped Parrotfish with 4 or less attacks. Larger Striped Parrotfish (size: 10 to 20cm) were attacked more often than smaller Striped Parrotfish (0 to 9cm). Additional surveys and data are needed to better understand the relationship between initial phase Striped Parrotfish and disturbances from damselfishes.

60. The developmental and molecular analysis of carpels pre- and post-fertilization in Aquilegia

Mankirat Kaur Pandher, Ana Alcaraz, Echeveste, Rene K Romo, Marianellie Bravo, Advisor: Bharti Sharma

Carpels bear the female reproductive organs of plants. Matured and fertilized carpels form fruit, and ovules develop into seeds. For the continuity of a plant species, timely pollination and fertilization are essential to ensure a successful seed set. Fruit development is a key process and has an immense economic impact on agricultural and horticultural crops. Despite carpels being the most crucial organs in plants that produce seeds, studies in horticultural crops that determine the genetic control of ovary, ovule, and seed development are rare. In the proposed study, we aim to unravel the genetic and

molecular bases of carpel development using Aquilegia coerulea as a model system. Aquilegia, commonly known as columbine, is a popular horticultural plant and a native of California. We have deployed developmental, molecular, and transcriptomic approaches to understand the genetic networks underlying seed formation. This study has identified crucial candidate genes that influence carpel and ovule development using RNA sequencing and differential gene expression analysis conducted on carpels from three developmental stages. The outcome of this research provides valuable data to better understand the gene expression changes that carpels undergo pre- and post-fertilization.

61. Morphology, Mortality, and Recruitment of Ferocactus cylindraceus in Relation to Herbivory and Elevation During a Prolonged Drought in the Sonoran Desert

Manuela Edwards, Advisor: Edward Bobich

Throughout most of the 21st century, drought associated with abnormally high temperatures has caused increased plant mortality in the Mojave and Sonoran Deserts. Despite its massive succulent stems, even California barrel cactus (Ferocactus cylindraceus), the largest cactus in the northwestern Sonoran Desert, appears to have experienced increased mortality and reduced recruitment over the last two decades. In this region, the species also appears to branch more frequently than would be expected based on the literature, which states that F. cylindraceus almost always has one single large stem. It also should be noted that evidence of herbivory by bighorn sheep has been observed in this region, which would lead to stem damage that could induce branching for this barrel cactus. To determine if branching must be induced by herbivory, the morphology of F. cylindraceus was characterized at two sites that bighorn sheep are known to frequent (300 m and 820 m in elevation), which have steep slopes and rocky substrate, and one that they are less likely to visit (200 m in elevation), which is flatter and has a sandier substrate. The percentage of branching of F. cylindraceus was highest at the site the bighorn are least likely to visit (17.3%) and was similar at the other two sites (300 m, 14%; and 820 m, 13%). Mortality of F. cylindraceus was highest at 17% at 300 m followed by 9.3% at 820 m and 6.4% at 200 m. Plants at the lowest elevation (200 m) were the largest, being significantly taller than the plants at the other sites, and having a greater diameter than the plants at 820 m. The results to this point of the study indicate that physical damage to stems by herbivores is not needed to induce branching in F. cylindraceus; however, the relative high mortality of plants at 300 m indicates that bighorn sheep could be partially responsible for increases in mortality that were noted beginning in the last major drought. To address the direct effects of herbivory on F. cylindraceus mortality and morphology, trap cameras are currently being set up at each site to monitor bighorn sheep (Ovis canadensis nelsoni) interactions with the barrel cacti.

62. Investigating the role of neutrophil extracellular traps in controlling acute Toxoplasma gondii infection

Marco Martinez, Advisor: Tatiane Lima

Approximately one-third of the global human population harbors an infection with the protozoan parasite Toxoplasma gondii. The immune system relies on neutrophils and one of their key mechanisms, neutrophil extracellular traps (NETs), to entrap and neutralize T. gondii. NETs are comprised of DNA, myeloperoxidase, citrullinated-histone 3, and elastase. Traditionally, it was believed that NET release led to neutrophil cell death. However, recent findings have suggested an alternative outcome - vital NETosis, which allows NET formation while preserving cell viability. While T. gondii induces NETs, the question remains whether these are released through vital NETosis. Additionally, the cellular interactions and signaling that trigger vital NETosis are unknown. The promyelocytic cell line HL-60 was differentiated into neutrophil-like cells (NLCs) using retinoic acid and DMSO. NLCs were then infected with T. gondii at a multiplicity of infection of 2 in the presence of SYTOX, a dye that binds to extracellular DNA. Fluorescence was quantified with a plate reader and compared with PMA-stimulated NLCs, an inducer of suicidal NETosis. Results showcased an increase in extracellular DNA in T. gondii-infected NLCs. Immunofluorescence microscopy at various time points was performed to confirm NET formation. Investigating NLC viability during later time points, a cytotoxicity assay measuring lactate dehydrogenase in supernatants from T. gondii infections was conducted, which demonstrated minimal LDH release compared to PMA-treated cells. The next stages of this project are determining whether neutrophil receptors mediate T. gondii-induced vital NETosis and if neutrophil vesicles play a role in extruding nuclear DNA without compromising the plasma membrane.

63. BMI1 Stability Is Potentially Regulated By USP16 In Breast Cancer Cells

Marissa Postlethwaite, Spencer Kline, Cooper Bennett, Kristin Lam, Advisor: Junjun Liu

BMI1 serves as a core subunit of the Polycomb Group Complex 1 (PRC1), functioning as an E3 ubiquitin ligase. Its pivotal role lies in epigenetically regulating tumorigenesis through the ubiquitination of histone H2A. It is overexpressed in various cancers including breast cancer, where it often exacerbates metastasis, thus BMI1 is considered an important oncoprotein. While studies, both from other research groups and our own, have elucidated transcriptional regulation of BMI1 in breast cancer, little is known about its posttranslational regulation.

Recently, our investigation revealed intriguing insights. We found that knocking down USP16 resulted in a decrease in the level of BMI1, whereas the addition of MG132, a proteasome inhibitor, caused an increase in BMI1 levels. Since USP16 acts as a deubiquitinase, this discovery suggests a potential role for USP16 in stabilizing BMI1 by counteracting its ubiquitination, thus preventing BMI1 from being degraded through ubiquitination. Although this finding is preliminary, it highlights the importance of further exploration. A deeper understanding of BMI1's complexities in breast cancer could open doors to the development of targeted strategies aimed at combating metastatic breast cancer.

64. Genome Sequence and Functional Analysis of Clostridium gasigenes DB1A T ,a Psychrophile Isolated from Vacuum-Sealed, Chilled Lamb-Meat

Mark Ortiz, Rekha Seshadri, Wei-Jen Lin, Advisor: Wei-Jen Lin

We report on the high-quality draft genome sequence and analysis of Clostridium gasigenes DSM 12272T, a Gram positive, anaerobic, bacilli, isolated from chilled packaged-lamb product samples from New Zealand. The genome has 4,056,506 bp with a GC content being 28.69%, total of 5 scaffolds and 11 contigs. Whole-genome based phylogenetic analysis shows C. sartagoforme jcm 1413T is the closest type strain to DSM 12272T. Functional analysis reveals a peroxisome pathway that may play a role in the psychrophilic behavior, atypical of Clostridia, while also producing volatile gaseous compounds in lower temperatures.

65. EFFECTS OF RESTORATION ON NATIVE PLANTS AT DIFFERENT AREAS IN A CANOPY IN A WALNUT WOODLAND

Mathieu Leger, Hannah Herrick, Camille Sanshu, Trent Heinrich, Advisor: Edward Bobich

Restoration of disturbed habitats is becoming increasingly necessary in Southern California as the loss of native plant cover due to habitat loss and invasive species increases. Invasive annuals are especially an issue in the under story of walnut woodland, which is dominated by Southern California black walnut (Juglans californica). In this study, I am determining the overall success of the species that were planted in a restoration project almost a decade ago. For the project, native species were planted under the canopies, at the driplines, and in the open areas between canopies of the walnut trees in a walnut woodland at the John T. Lyle Center. I hypothesized that native species that typically occur within walnut woodlands will have the highest survival, greatest relative size, and greatest CO2 uptake in the woodland. I also hypothesized, based on previous work at this site, that the plants at the dripline will have greater success than those at under the canopies and in the open. To test the hypotheses, assessments of mortality, morphological measurements, and growth of each plant are being conducted for all living plants. To determine how physiology is affected by location in the woodland, measurements of gas exchange (taken seasonally), maximum quantum efficiency of photosystem II (FV/FM; taken monthly), and water potential (monthly) are being taken for Heteromeles arbutifolia, Frangula californica, Salvia apiana, and Salvia mellifera. Within most species, survival was highest for plants in the open and lowest under walnut canopies; however, survival was similar with respect to location when all species were considered. Height and plant spread differed with species and location with respect to walnut canopy coverage. FV/FM changed little with time and location but did differ among species. Water potential differed among species and date but not with location. CO2 uptake and transpiration differed with location for all four species, but stomatal conductance did not, indicating that the external factors (light and temperature) are completely affecting gas exchange and not stomatal control. Based on these preliminary

results, it appears that differences in survival and physiology are based more on species differences and water availability than canopy coverage. However, plant size is affected by walnut canopy coverage, which may be due to light availability and the physical barriers of the walnut trees rather than the presence of juglone, which is an allelochemical that walnuts produce.

66. Organism Diversity on Red Mangrove Roots with Differing Freshwater Inputs

Jaime Neill, Sandra Dansereau, Matthew Kim, Daniel Sebastian, Samantha Bollinger, Advisor: Jeremy Claisse, Ángel Valdés

Mangroves are a highly productive and important ecosystem found along subtropical and tropical coasts. In Bocas del Toro, Panama, the red mangrove, Rhizophora mangle, is the dominant mangrove species. Red mangroves exhibit a complex network of aerial roots to assist with both stability and oxygen absorption. These submerged roots provide valuable nursery habitat to juvenile fish and increased surface area for sessile invertebrates and algal species to attach. In some areas, these microhabitats experience fluctuations in salinity concentration due to the influx of freshwater from inland waterways. To explore this further, our group conducted a pilot study assessing the diversity of encrusting species on red mangrove roots between sites with varying levels of freshwater input, as part of the Spring 2024 BIO 4550/L Field Biology (Panama Tropical Marine Ecology) Course. We hypothesized that the assemblage of species on different mangrove roots would be correlated to the amount of freshwater input at each site. To investigate our hypothesis, we recorded the presence/absence of encrusting species (sponges by morphology, algae by species, and other species by higher taxonomic classification) among red mangroves from 3 different sites with differing levels of freshwater input: Casablanca (low), Punta Caracol (med), and Ground Creek (high). We randomly selected submerged root systems (total n = 40) at each site and recorded the presence/absence of species within a 1m2 quadrat at the mangrove edge. The benthic habitat within and adjacent to the sampled root systems were also described. Community composition was different between sites, which is illustrated in a non-metric multidimensional scaling (nMDS) plot with species vectors showing which organisms were driving these patterns. These findings indicate that varying levels of freshwater input may affect sessile organism diversity on red mangrove roots. Additionally, the adjacent Caulerpa meadow habitat is found exclusively at Ground Creek, which has the highest amount of freshwater input.

67. Characterizing Signaling and Localization of Daple-FLT3 Gene Fusions in Leukemia Cells

Michael Acquazzino, Advisor: Jason Ear

Receptor tyrosine kinases (RTKs) are cell surface receptors that regulate cell survival, cell proliferation, and cell migration upon ligand binding. Genetic mutations leading to

constitutive RTK hyperactivation and overactivation of downstream signaling are often seen in cancer. In some hematological malignancies, the coiled-coil domain (CCD) of Daple, a cell signaling scaffold protein, has been found in gene fusions with the RTKs FLT3 and PDGFRB, and to the intracellular kinase JAK2. It is hypothesized that the gene fusion product causes the tyrosine kinase domain of FLT3 to become activated and mislocalized in cells, leading to rampant cell signaling of key molecules such as MAPK, AKT, and STAT5. Using fluorescently tagged Daple-FLT3, it was shown that the gene fusion is subcellularly localizes to the peri-centrosome space across all leukemia cell lines tested. Ectopic expression demonstrated activation of the kinase domain and subsequent increases in phosphorylation of STAT5a, AKT, and MAPK. Further investigation is needed to identify the direct substrates of the Daple-FLT3 gene fusion as well as the transcriptional changes that occur in cells. The outcome from this work may unveil novel therapeutic strategies into targeting this protein in cancer.

68. Investigation of the bovine neutrophil response to STI parasite Tritrichomonas foetus

Michael Berry, Advisor: Frances Mercer

Bovine neutrophils kill the protozoan parasite Tritrichomonas foetus using a mechanism known as trogocytosis, which involves the removal of fragments of the parasite membrane. Tritrichomonas foetus is the causative agent of trichomonosis, a recurring sexually transmitted infection that occurs in cattle and can cause spontaneous abortion in pregnant cows. Though it is known that bovine neutrophils kill T. foetus parasites by trogocytosis, the mode of death of the parasites following trogocytosis is unknown. We plan to test if the parasite undergoes apoptosis or lysis after neutrophil trogocytosis. In the closely related protozoan parasite T. vaginalis, there is variability in parasite strain resistance to human neutrophil killing by trogocytosis. Whether there is variability in bovine neutrophil killing of T. foetus is unknown. The T. foetus parasite strain KV-1 used previously to study bovine neutrophil killing will serve as the baseline to compare two other T. foetus strains, BP-4 and Belfast, resistance to neutrophil killing. The mechanism by which different T. vaginalis parasite strains are more resistant than others is unknown, however a current hypothesis is that the resistant parasite strains are more effective at membrane repair, a known mechanism of cell survival in mammalian cells. We plan to compare resistant strains of T. foetus to the susceptible strains in their ability to repair their membranes. These studies will further our knowledge of the bovine neutrophil trogocytic response to Tritrichomonas foetus, and may aid in understanding the weak bovine immune response to T. foetus.

69. Ecological Restoration Begins With Seed: Plant Seed Trait Variation Among Species And Populations

Michael Krynen, Advisor: Ehren Moler

This study examined seed mass variation and germination rates of two native California coastal sage scrub species, Acmispon glaber and Salvia mellifera, important species for ecological restoration. We found A. glaber seeds were heavier and germinated more quickly and consistently than S. mellifera. While seed mass correlated with seed source population, it did not show broader climate zone patterns. Populations from Angeles National Forest exhibited the highest germination rates for A. glaber, supporting Baker's Rule. These findings offer insights for restoration strategies, highlighting A. glaber's suitability for reintroduction efforts.

70. Cerberilla Sea Slugs - Mapping Diversity and Phylogeny

Michelle Millan, Advisor: Ángel Valdés

Throughout the lab's expeditions to the South Pacific island of New Caledonia, several specimens of Cerberilla sea slugs have been collected. Collected by the island's capital, Nouméa, about twenty specimens from this region are to be analyzed to determine their identity. These sea slugs are apart of the family Aeolidiidae, which is considered one of the largest clades of nudibranchs. The direct systematics of the Cerberilla has been unclear, as some species have been questioned as to whether they should be considered Aeolids. Aeolidiidae is a monophyletic group, meaning the group has all descended from one common ancestor. However, there has been evidence that this may not be the case. Exploring these genera further will only aid in our understanding of these families and hopefully results in clearer and more organized information.

71. Analysis of Alcohol Intake and Thiamine Deficiency on hMSC differentiated neurons

Elijah Huang, Noah Gutierrez, Beatriz Jiminez, Miriam Khalil, Advisor: Steve Alas

Our research group is looking to test the effects of alcohol consumption, at the 0.08% legal driving limit, on human neurons in people with thiamine deficiency. Specifically, are we differentiating human mesenchymal stem cells (h-MSCs) into neuronal cells by inducing the hMSCs with neurogenic differentiation media. In order to simulate thiamine deficiency, the cells are treated with amprolium. Amprolium is a thiamine analogue/antagonist that blocks thiamine receptors, and interferes with thiamine metabolism. Using amprolium-induced thiamine deficiency should mimic Wernicke-Korsakoff Syndrome, in which the neuronal cells are no longer up taking thiamine and struggle to perform carbohydrate synthesis. We hope to analyze whether the legal limits of alcohol consumption induce cell death in neuronal cells from Wernicke-Korsakoff Syndrome patients.

72. Transcription analysis of human neutrophils infected with Toxoplasma gondii

Morgan Saunders, Advisor: Tatiane Lima

Toxoplasma gondii is an obligate intracellular parasite that widely affects the human population. This parasite has been shown to invade and replicate in host cells for extended periods through the prevention of apoptotic pathways. A large proportion of human T. gondii infections are attributed to the contamination of water or food by feline fecal matter, leading to infections arising in the intestines and migrating across systems as it transitions into chronic infection. Along with neutrophil infiltration into the intestinal area during T. gondii infection, the presence of gram-negative bacterium species, composing the gut microbiome, is also prevalent in the area. Considering these combining factors, we aim to further characterize the interaction between T. gondii and the innate immune system, particularly mechanisms that T. gondii utilizes to manipulates neutrophils for survival through changes in gene regulation while other species simultaneously activate immune responses in these cells. To observe, analyze, and quantify these transcriptional changes, we performed RNA sequencing to determine gene regulation in neutrophils infected with type 1 T. gondii parasites and human neutrophils infected with a combination of these parasites and lipopolysaccharide (LPS). Our findings showed that T. gondii not only reduces apoptotic mechanisms in infected neutrophils, but it also suppresses the immune response induced by LPS, for example, by limiting microbicidal reactive oxidative species (ROS) through the CYBB gene.

73. Examining effects of tidal elevation on the black tegula and potential causes for their distribution in the rocky intertidal

Natalie R. Gonzales, Joselynn Hoyos, Jose L. Huizar, and Cassandra Vivas, Advisor: Dr. Carla Stout

The population distribution of the black tegula (Tegula funebralis) in a rocky intertidal community is analyzed in the following study. We focus on density variations across increasing tidal elevations. We collected density and distribution information for the black tegula at Cabrillo Beach in California. Statistical testing revealed a substantial increase in black tegula density, specifically at a tidal elevation of 15 feet where we found the highest number of tegulas per ft2. This variation in density among different elevations indicates that 15 feet is the preferred tidal elevation for the black tegula. We believe that there may be competition for space as well as physical, chemical, and biological factors within the intertidal environment that are contributing to the difference in black tegula density through rising elevations. The tegula's desiccation-resistant anatomy and mobility allow for it to be successful at high elevations by reducing desiccation risk and enhancing access to resources crucial for their diet, such as algae. We also look into how ocean acidification as well as behavioral adaptations may also play a role driving this distribution In addition, behavioral adaptations, such as predator detection mechanisms, might influence their choice of higher elevations, reducing predation risks.

74. Microbial Diversity Analysis of Soil Samples from Heteromeles Arbutifolia and Urban Roadside

Pilar Cuadros Arias, Francis Sullivan, Advisor: Sydnie Chase

Nestled within the broader ecological landscape of native plant communities, the California Toyon is home to a diverse array of soil microbial communities, captivating the attention of researchers engaged in ecological restoration endeavors. This study aims to investigate the diversity of soil microbial communities by comparing soil samples collected from California Toyon native plant garden and urban roadside area. Through molecular analysis, we aim to illuminate microbial differences between the two environments. A fresh sample was cultured on various types of media and inoculated into an EcoPlate. Colony and EcoPlate comparative analysis suggest high diversity within the two data sets. In addition, the 16S rRNA gene was amplified via PCR, cloned into the TOPO-TA vector, transformed in E. coli, and sequenced. Sequencing results suggest a genetic match to Planctomycete in roadside sample and Phycisphaera in native garden sample. Further investigation could potentially involve individual analysis and characterization of the microbial community at California Toyon native plant garden to assess the impact of urbanization on soil microbial communities.

75. Kaposi's Sarcoma-Associated Herpesvirus Targeting of CD1c by the K8.1 Glycoprotein

Randy Hernandez, David J. Sanchez, Advisor: David Sanchez

Kaposi's Sarcoma is a form of cancer that is primarily caused by infection from Kaposi's Sarcoma-Associated Herpesvirus (KSHV), the 8th known Human Herpesvirus (HHV8), especially in person who is immunocompromised. It is currently understood that CD1 proteins found on specific antigen presenting cells, such as dendritic and B Cells, are a key part of initiating innate & adaptive immune responses. Within the CD1 protein family is a specific protein known as CD1c, which is responsible for activating CD1c-restricted T Cells. Our group found that a KSHV-encoded glycoprotein, K8.1, is able to inhibit expression of CD1c, which may allow KSHV to spread infection more efficiently by avoiding CD1c-restricted T Cells. K8.1A, which is the full length K8.1 open reading frame, downregulates CD1c, while K8.1B, which was missing a 61 amino acid domain of the N-terminal side, does not. We hypothesize that this domain in K8.1A is responsible for the downregulation of CD1c by K8.1. We synthesized different cDNAs of the K8.1 protein (K8.1A, K8.13, K8.14, K8.1ΔTM) into expression plasmids to determine the protein domains that allow for downregulation of CD1c. We transfected these plasmids of the K8.1 protein into HEK293T cells to study the individual protein structures. We found that the mutants that we generated all produce proteins at different sizes using western blot and these sizes correspond to different processed forms. Our next step is to see how these proteins impact co-transfected CD1c. In conclusion, this work is important towards understanding this mechanism KSHV used to avoid immune activation by downregulating CD1c, and how these methods allow the rapid growth of KSHV in the development of Kaposi's Sarcoma.

76. Measuring Spacecraft Associated Spore Resistance to Ultraviolet Radiation and 3% Hydrogen Peroxide

Ritika Masson, Kailee Martinez, Advisor: Wei-Jen Lin

As part of Planetary Protection procedures to prevent microbial contamination on outbound spacecraft, samples are taken from the surface of the spacecraft during construction for microbial analysis and isolation. This is done to minimize the microbial burden the spacecraft carries to outer space. A modified Most Probable Number (MPN) method was used to evaluate the ability of fourteen spacecraft-associated fungal isolates for their survival under two forms of microbial control commonly employed during construction and spaceflight. Fungal conidia were exposed to short-wavelength ultraviolet radiation (UV-C) and 3% hydrogen peroxide on aluminum coupons and enumerated post-exposure to determine the number of remaining active conidia.
The UV-C test was conducted with and without simulated martian soil to emulate a "shading" effect on the conidia that may affect the survivability rate. Post-exposure analysis of each isolate demonstrated that Aspergillus. calidoustus showed the highest level of survival under UV-C among all examined strains. Notably, A. calidoustus showed higher survival rates post-exposure than Bacillus. pumilus SAFR-032, the current "gold standard" for ultraviolet radiation resistance. Furthermore, the UV-C survivability of both fungal and bacterial spores was affected by the presence of soil which may potentially provide a physical barrier between the UV rays and the cells. The effect of hydrogen peroxide on conidia survivability will be investigated using a similar experimental design.

77. Characterization of Genomic Changes During Human Adipogenesis

Ruomei Wang, Advisor: yuanxiang zhao

Adipogenesis is the process through which functionally uncommitted stem cells or progenitor cells differentiate into adipocytes (fat cells). Better understanding in human adipogenesis will help shed lights on our understanding of adipose tissue development and regulation, as well as potential new therapeutic approaches to treat obesity-related diseases. Human mesenchymal stem cells (hMSCs) are found in bone marrow, adipose tissue and peripheral blood. They can be easily expanded and upon receiving appropriate stimuli, induced to differentiate into several functionally specialized mature cell types including adipocytes, making them a valuable in vitro cellular model for studying adipogenesis. Study from this lab has shown significant nuclear changes during this adipogenic differentiation process, with the average nuclear size of adipocytes being significantly smaller than those of non-adipocytes in the same culture. It is not clear however what might have caused the nuclear size change, and one plausible explanation could be due to genomic DNA structural changes and/or loss. This study aims to uncover potential genomic changes during adipogenesis by comparing adipocytes to non-adipocytes at 6 different time points of differentiation,D7, D14, D21, D30, D45 and D60. Comet assay is utilized to assess and compare DNA damage between isolated adipocytes

and non-adipocytes at the single-cell level by measuring the extent of DNA fragmentation and migration. Additionally, cell-free DNA assay is being used to quantify DNA that might have been released into the spent media in cell culture at different stages of adipogenic differentiation. Preliminary results from Comet assays indicated greater fragmentation and loss of DNA in adipocytes as compared to non-adipocytes. Cell-free DNA assays are being conducted to examine potential trend in the amount of DNA released into the media during adipogenic differentiation.

78. The Effects of Maternal Exposure to Δ9-THC During the Period of Rapid Placental Growth on Fetal Growth in Swiss Webster Mice

Sandra Banzon, Zoe Walker, Advisor: Juanita Jellyman

Introduction: Over the past decade, marijuana use has increased, including use by pregnant women. Exposure to the psychoactive phytocannabinoid in Cannabis sativa, delta-9-tetrahydrocannabinol (Δ9-THC), throughout pregnancy decreases birth weight in humans and animals. However, whether maternal exposure to Δ9-THC during the period of rapid placental growth (gestational days 11-16) decreases fetal weight is unknown.

Methods: All experiments were approved by the Institutional Animal Care and Use Committee at Cal Poly Pomona. Pregnant Swiss Webster mice were untreated (control group, n=24), received an intraperitoneal (IP) injection of vehicle (ethanol, cremophor, and saline;1:1:18; vehicle group; n=21), or 4 mg/kg Δ9-THC in vehicle (Δ9-THC group; n=20). After euthanasia on day 16 or day 19 of gestation (term~20 days), fetuses and their placentas were weighed, and the fetal:placental ratio was calculated as an index of placental efficiency.

Results: When data were analyzed for placentas on day 16, there was no difference in placental weight among the groups. There was a difference in placental weights on day 19 in the control, vehicle-treated, and THC-treated (0.08±0.003 g; 0.08±0.004 g; 0.09±0.001 g; $P<0.05$) mice, respectively. There was a difference in fetal weights on day 16 in control, vehicle-treated, and THC-treated (0.43±0.02 g; 0.47±0.03 g; 0.46±0.04 g; $P<0.05$) mice, respectively. Fetal weights on day 19 were different in control, vehicle-treated, and THC-treated (1.20±0.04 g; 1.25±0.03 g; 1.18±0.03 g; $P<0.05$) mice, respectively. Male placentas on day 19 (0.09±0.003 g; 0.09±0.004 g; 0.09±0.003 g; $P<0.05$) were different in comparison to male placentas on day 16 (0.09±0.004 g; 0.09±0.004 g; 0.09±0.004 g). Female placentas on day 19 (0.09±0.003 g; 0.09±0.004 g; 0.09±0.003 g; $P<0.05$) were different in comparison to female placentas on day 16 (0.08±0.005 g; 0.08±0.003 g; 0.08±0.006 g). Male fetal weights were different on day 16 (0.43±0.01 g; 0.48±0.03 g; 0.44±0.03 g) and day 19 (1.23±0.04 g; 1.28±0.05 g; 1.21±0.03 g). Female fetal weights were different on day 16 (0.43±0.02 g; 0.45±0.03 g; 0.45±0.04 g) and day 19 (1.19±0.03 g; 1.23±0.03 g; 1.15±0.04 g).

Conclusion: The data suggests that maternal exposure to Δ9-THC during the period of most rapid growth of the placenta does alter placental and fetal growth.

79. FLORAL VISITATION FREQUENCIES OF FEMALE AND MALE SQUASH BEES TO YELLOW SUMMER SQUASH AT TWO SUBURBAN FARMS

Sara Witt, Joan Leong, Advisor: Joan Leong

Squash bees (Eucera, subgenera Peponapis and Xenoglossa) are critical pollinators of cultivated squash and pumpkin in agricultural areas. The small squash bee Eucera (Peponapis) pruinosa and larger squash bee Eucera (Xenoglossa) strenua are native solitary bees found in southern California and other parts of North America that are specialist pollinators of squash flowers (Cucurbita species). Although there have been studies of Eucera (Peponapis) pruinosa in North America, studies regarding squash bees, and especially Eucera (Xenoglossa) strenua are lacking in southern California. This project aims to provide an understanding of squash bee floral visitation frequencies to yellow summer squash flowers. We compared the floral visitation frequencies of male and female Eucera (Peponapis) pruinosa and Eucera (Xenoglossa) strenua to patches containing yellow summer squash flowers at suburban farms in southern California. Bee visitation of summer squash flowers was observed and recorded between July and August 2023 at Black Sheep Farm and Spadra Farm. Bee species and sex, and flower sex were recorded during 10-minute observation periods in randomly selected 1m2 plots containing one or two open squash flowers. Observations occurred between 6:30am and 11:00am when squash flowers were open. Using a Wilcoxon Rank Sum Test, we found significant differences in male and female squash bee floral visitation frequencies to plots with two male flowers ($p<0.001$, $n=9$) and plots with one male flower at Spadra Farm ($p<0.001$, $n=25$) and plots with two male flowers at Black Sheep Farm ($p=0.05$, $n=11$).

80. The Inverse Correlation between Alzheimer's disease (AD) and Cancer

Sophie Biehler, Advisor: Glenn Kageyama

Alzheimer’s disease (AD) is a neurological disorder that occurs in part of environmental, genetic, and age-related factors that damages and impairs the brain until it shrinks, causing vital brain cells and neurons to die. Approximately 6.5 million individuals within the United States ages 65 and older have been diagnosed with AD, and there is an expected increase in projected diagnoses by almost triple by the year 2060 (8). Another leading cause of death within the United States is cancer, and is projected to be on the rise as well, due to environmental factors and genetic-related disorders. Recent evidence suggests that there’s an inverse correlation between the developmental processes of AD and cancer, essentially stating that the susceptibility to one disease can help protect against the other disease. The focus of this mini-review is to pinpoint and understand the protein p53, as well as the Wnt signaling pathway, the cell cycle, enzyme Pin1, metabolic and oxidative stressors, and how imbalances of these factors create an inverse correlation between cancer and neurodegeneration. There are many other correlated factors that contribute to the developmental processes of both cancer and AD, and understanding the

complexities associated with the formation of these diseases will help give individuals an understanding of preventative measures that can be put into play to increase the longevity of life.

81. Preliminary Study of Molecular Mechanism Regulating Ovarian Cancer Invasion

Spencer Kline, Marissa Postlethwaite, Kristin Lam, Cooper Bennett, Advisor: Junjun Liu

High grade serous ovarian cancer (OC) is the most aggressive subtype and accounts for the majority of advanced stage cases (1) (Fig. 1A). The intricacies of OC invasiveness regulation are multifaceted, yet BMI1 emerges as a pivotal player, frequently overexpressed in high-grade serous OC. BMI1 serves as a core subunit of the Polycomb Group Complex 1 (PRC1), which functions as an E3 ubiquitin ligase. By ubiquitinating histone H2A, BMI1/PRC1 play a crucial role in epigenetically regulating tumorigenesis by initiating the repression of tumor suppressor genes.

82. Investigating genetic systems for Sulfolobus species infected with Sulfolobus Turreted Icosahedral Virus 3

Sydnie Chase, Chloe Cornejo, Advisor: Jamie Snyder

Sulfolobus Turreted Icosahedral Virus 1 (STIV1) is a virus that infects Sulfolobus solfataricus and is genetically distinct from other viruses infecting archaea yet share some similarity with viruses infecting the other domains. Recently, another STIV-like virus (STIV3) was detected in the genome of S. acidocaldarius from Yellowstone National Park. To facilitate the creation of viral mutants, a genetic system was created for STIV3, but not for its S. acidocaldarius host. STIV1 and STIV3 are very similar but do have few distinct features, such as STIV3 integrates into its hosts genome whereas STIV1 does not. The goal of this project is to develop a genetic system for the STIV3 host, S. acidocaldarius so we can manipulate both pathogen and host to elucidate the STIV3 replication cycle. The genetic system for S. acidocaldarius will be modeled after a system previously developed for S. acidocaldarius, which consists of constructing targeted deletion mutants. Once these mutants are made, the host will be infected with STIV3, and viral replication observed. So far, the plasmid pSC01 has been successfully constructed and confirmed via Sanger sequencing. Currently, development of the Sulfolobus KO with pSC01 is underway. Developing a genetic system for the host of STIV3 will allow us to conduct further study on the virus-host interactions that are currently not well understood.

83. COMPARISON AND DISCOVERY OF MICROORGANISMS THROUGH MICROBIOLOGICAL TECHNIQUES FROM ENVIRONMENTAL SAMPLES

Joselyn Torres, Valeri Diaz, Advisor: Sydnie Chase

This study involved the utilization of both “old” and “new” techniques in order to identify and classify the types of microbiota communities in two distinct environments. Due to the differences in locations, it would be very difficult to be able to recognize any contrasting or similar types of organisms without further investigation; this information would prove to be crucial towards classifying certain attributes for our microbial communities in the two samples. Perhaps the different environments could prove that a common bacterial species is capable of adapting in different conditions regardless of the fluctuations in nutrients, sunlight, etc. Although both samples were derived from aquatic sources, based on the locations and the different biotic interactions that both have, it can be hypothesized that there will be a larger amount of diversity abundance and richness in the pond as opposed to the fountain water. Though culturing provides a general sense of diversity by visualization, sequencing gives the most insight on the types of organisms residing in the samples, alongside the EcoPlate™ findings. This proved to be inconclusive as the EcoPlate™ readings came back pretty similar to one another, as was not expected. However, the sequencing did show more diversity in possible species in the pond water. All the work that was put into this project was to show just how diverse bacteria are, and how resilient they can be. Many are able to live in very different ecosystems, such as in contaminated water or in a pond, and still thrive in their respective locations. They are important contributing members to our planet, and without them there would be grave consequences.

84. Toxoplasma gondii and the brain: Understanding the systemic effects of toxoplasmosis in changes in GLT-1 expression and synaptic pruning

Venjaminne Fua, Advisor: Tatiane Lima

Toxoplasma gondii is an intracellular parasite that infects approximately one-third of the global human population. This parasite causes toxoplasmosis, a pathogenic infection that is neglected and underrepresented in science and medicine. Although most acute infections are mild or asymptomatic, T. gondii can cross the blood-brain barrier and establish a chronic infection in the brain. Recent evidence indicates that chronic T. gondii infection causes a decrease in the expression of the astrocytic glutamate transporter (GLT-1), subsequently inducing an increase in extracellular glutamate. Excessive amounts of extracellular glutamate can be neurotoxic and lead to cognitive decline and psychiatric disorders. Recent literature has shown that T. gondii expresses parasite virulence factors that are secreted into the host cell and dysregulate NF-κB signaling, the main transcription factor for GLT-1. Our preliminary in vivo studies suggest that this is not the case, thus leaving an open question as to what transcription factor could be playing a role in mediating GLT-1 promoter activation. Increased levels of extracellular glutamate overstimulates NMDA/AMPA receptors and opens voltage gated calcium ion channels. Thus, resulting in high calcium ion influx, caspase 3 and 9 activation, and exposure of phosphatidylserine to stimulate synaptic pruning by astrocytes. We hypothesize that decreased GLT-1 expression has a systemic effect on synaptic pruning. In vitro, we have established parasite differentiation from T. gondii tachyzoites (life stage found in the

acute infection) to bradyzoites (life stage found in the chronic infection) using neural progenitor stem cell line NE4C infected with type II T. gondii (Pa-7 GFP) tachyzoites at a multiplicity of infection (MOI) 1. Bradyzoite differentiation was induced by maintaining the culture under stressful conditions (alkaline pH and low CO2). Our in vitro studies have shown there is a decrease in GLT-1 expression 3 days post infection (dpi). In addition, we have been able to establish an in vivo model using C57BL/6 mice for behavioral studies. Early preliminary data suggests at 28 days post infection (dpi) the most cognitive decline is appreciated using the Barnes maze. Whole frontal lobe lysates have shown a decrease in GLT-1 expression at 28 dpi thus validating our behavioral studies. Our future experiments include looking into different transcription factors (CREB, REST, and Yin Yang 1) as potential regulators of GLT-1 expression in vitro. Additionally, we will evaluate how extracellular glutamate may affect calcium influx in neurons leading to neuronal damage. In parallel, we will use C57BL/6 mice as a model to test changes in transcription factors in vivo, measuring GLT-1 expression and monitoring behavioral and cognitive changes associated with psychiatric disorders.

85. Genome Sequence and Functional Analysis of Dysgonomonas hofstadii DSM 104969 Isolated from Human Surgical Wound

Virginia Jacinto-Torres, Rosita Mohanty, Guadalupe Bernal, Rekha Seshadri, Advisor: Wei-Jen Lin

In collaboration with the DOE Joint Genome Institute (JGI) and The One Thousand Microbial Genomes Phase 4 (KMG-IV) Project, we present the genome statistics, functional analyses, sequencing, and assembly of the draft genome of Dysgonomonas hofstadii DSM 104969T. D. hofstadii is a type strain, isolated from an abdominal surgery wound of a 72-year old male at the Helsinki University Central Hospital, in Helsinki, Finland in 2007. The genome was sequenced by Illumina NovaSeq platform generating 10,372,436 raw reads. After sequence read filtering, assembling, and gene annotation, the final draft genome has 46 contigs in 44 scaffolds with 296.8x coverage. D. hofstadii DSM 104969T has a genome of approximately 5.03 Mb and 4,321 genes with a GC content of 39.27%. The phylogenetic analysis using the whole-proteome-based analysis by the Type Strain Genome Server (TYGS) indicates that the closest neighbors are D. gadei and D. mossi, and the closest non-Dysgonomonas is Tannerella forsythia. Functional analyses via JGI's Integrated Microbial Genome (IMG) suggest unique anti-restriction factors such as ArdA and ArdC, as well as multiple drug resistant genes within this type strain bacterium.

86. Investigating Extracellular Degranulation and Optimizing Degranulation Deficiency in Neutrophil-Like Cells

Ximena Corona, Suhani Bhakta, Bethany Sesti, Advisor: Frances Mercer

Every year, more than 3 million Americans are infected by the protozoan parasite Trichomonas vaginalis, and cases worldwide have reached 400 million, making it the third most common sexually transmitted infection. Trichomoniasis, although largely

asymptomatic, may be coupled with painful urination, “frothy” vaginal discharge, and pelvic discomfort. More concerningly, Trichomoniasis infections are associated with several reproductive complications, such as preterm labor. Additionally, trichomoniasis has been found to be correlated with HPV positive patients’ increased progression of cervical neoplasia. We aim to study the way the human immune system mounts a response against the pathogen, which begins at the site of infection, where neutrophils rapidly swarm, degrade and trogocytose the parasite. During degranulation, the protein STXBP2 mediates the assembly of the SNARE-complex allowing toxic granules to fuse with the neutrophil’s plasma membrane that in turn releases the contents of the granule extracellularly. We hypothesize that degranulation serves to degrade the surface of the parasite, helping facilitate trogocytosis. We also hypothesize the gene STXBP2 plays a critical role in degranulation, and secondly, we hypothesize that neutrophil-like cells will have a reduced ability to kill Trichomonas vaginalis if they are incapable of degranulating. To test this hypothesis, we will knock out STXBP2 using CRISPR/Cas 9, and then introduce these degranulation-deficient neutrophil like cells to the parasite in a co-cultured cytolysis assay followed by a trogocytic assay, which will determine if the neutrophil-like cells are still able to kill the parasite via trogocytosis.

87. Large layer V neocortical pyramidal neurons express elevated levels of oxidative metabolic activity in several carnivore and primate species.

Yaman Sebai, Clara Guirguis, Sophie Biehler, Ayah Elsamad, Advisor: Glenn Kageyama

The mammalian neocortex, is comprised of six layers that differ by neuronal types, level of metabolic activity, and patterns of interconnectivity. We investigated layer V of the neocortex due to the presence of larger pyramidal neurons that have been shown previously to exhibit higher levels of metabolic activity in the cat visual cortex. Cytochrome c oxidase (CO) a large mitochondrial protein complex is the terminal electron acceptor in cellular respiration and is required for the generation of most of a cell’s ATP. CO staining is considered the standard for assessing the relative levels of neuronal oxidative metabolic activity. Preliminary findings have shown that there is a distinct pattern of distribution of CO-rich neurons within the neocortex of many different species of mammals, a detail largely overlooked. We conducted a morphometric analysis via enzyme histochemical CO-stained cortex tissue of several carnivore and primate species and measured the diameter of CO reactive and CO unreactive neurons within Layer V. Our results indicate that the darkly CO-reactive pyramidal neurons are significantly larger (+52% diameter) than the neighboring smaller and lighter staining neurons. We theorize these larger, more reactive pyramidal neurons fall under the classification of “Meganeurons,” highly metabolic and physiologically active projection neurons, found in specific cortical areas throughout the brain and also tend to be more prominent in higher-level cognitive species. Loss of these neurons has been associated with neurological diseases such as Alzheimer’s disease, frontotemporal dementia (von Economo neurons), and ALS (Betz cells), two specific types of mega neurons. We suspect studying these neurons is vital to furthering our understanding of these important neurological diseases.

CHEMISTRY AND BIOCHEMISTRY

88. Synthesis of a Bis(Imidazolium) Salt with a Xylyene Linker and Methyl Backbone

Adam C. Bryant, Chantal E. Stieber, Advisor: Chantal E. Stieber

The poster discusses the synthesis of Bis(imidazolium) salt via a starting material containing a methyl backbone. We were about to obtain our salt by first working on our imidazole compound which posed a route of purification to be different than the normal mesityl imidazole. The use of flash chromatography was necessary in this case because multiple attempts at recrystallization led to no crystals. Further down into our research, we were able to produce bis(imidazolium) salt with our imidazole starting material, which has not been previously reported, and further research will be done from here to determine the effect of ligand substituents on catalysis.

89. Effects of 3D-printed Smartphone Spectrometer Background on Crystal Violet Analysis

Adrian Adriano-Bueno, Matthew Liu, Advisor: Yan Liu

Crystal violet, an intense colored dye, has been primarily used as a histological stain to visualize cell viability. This research project explores a new affordable analytical method for crystal violet measurement. Smartphone spectrometers take advantages of the 3D-printed structure and optical performance of a smartphone, making them an ideal candidate for this study. A 3D structure was thus designed and printed. Coupling with a smartphone, the printed structure was applied toward crystal violet measurement using the red, green, and blue intensities, collected via a free smartphone color reading APP. The collected data indicated that 1) Blue measurements did not generate valid calibration curves, no matter what types of surfaces used; 2) Red and Green measurements generated valid calibration curves, no matter what types of surfaces used; 3) Greater measurement sensitivity was obtained on white background than reflective surface; and 4). Results were found to be comparable to those obtained by the classic UV-vis spectrometry. Future study of this project will be focusing on improving the reproducibility of the light sources used and applying the smartphone spectrometer for the kinetic study of crystal violet hydrolysis.

90. Reactivity of N-heterocyclic carbene nickel(0) complexes for CO2 reduction

Alyssa Tran, Advisor: Chantal Stieber

Greenhouse gas emissions contribute to a concerning increase in the global temperature, with CO2 being of significant concern. CO2 activation with transition metal catalysts can be an effective method for greenhouse gas reutilization. This work aims to probe CO2

activation with bidentate N-heterocyclic carbene (NHC) Ni(0) complexes and captured CO2 sources. Bis(imidazolium) salts as ligand precursors can be synthesized from substituted imidazoles reacted with dihaloalkanes. This work created a new bis(imidazolium) salt using bifonazole (BIF) and dibromomethane to form [BIFNHC2Me][Br]2. The NHC ligand was formed by deprotonating a bis(imidazolium) salts, [tBuNHC2Me][Br]2 or [BIFNHC2Me][Br]2, using two equivalents of KHMDS. The NHC2 was then reacted with Ni(COD)2 to form (tBuNHC2Me)Ni(COD) or (BIFNHC2Me)Ni(COD). These NHC2Ni(COD) complexes were tested with captured CO2 sources in the form of imidazolium carboxylates and under electrochemical conditions.

91. Designing and Integrating/Implementing Literature Figure Interpretation Activities in Analytical Chemistry Curricula

Amy Hua, Advisor: Yan Liu

Primary research literature is an essential resource for students to bridge the gap between their course knowledge and real-world applications. To assist college- and university-level STEM students in developing research article interpretation skills, many attempts have been attempted to design and incorporate research literature activities in higher education STEM classrooms. Such classroom activities in analytical chemistry courses, however, are scarcely reported. This project involves designing a classroom activity that guides students through the analysis of literature data and figures in analytical chemistry and implementing it in one undergraduate lab course at Cal Poly Pomona. During the class period, students were guided through interpreting a literature figure question set that was developed and formulated based on Marzano's Taxonomy framework. The pre- and post-activity survey results suggested that students gained familiarity and confidence with analyzing figures in research papers and improved their research literature reading skills. Such a literature interpretation activity could be potentially implemented in other analytical chemistry courses.

92. Investigating the Impact of Reagent Supplier on the Crystallization of Two Enzymes

Astrid Ardon Lopez, Jenessa Lopez, Luis Gonzales, Melia Moran, Advisor: Kathryn McCulloch

X-ray crystallography has immensely helped understand biological macromolecules by allowing for structure determination at near-atomic resolution. This method is of special interest for proteins, as their structure is directly tied to their mechanism of action. The formation of protein crystals suited for x-ray crystallography is a complicated process as suitable protein crystals must achieve supersaturation levels to diffract with high definition, and every protein has a specific set of conditions to reach that level involving protein concentration, temperature, pH, buffer, precipitants, and additives. These conditions can only be determined by trial and error as there is no way to predict what conditions will yield diffraction-quality crystals. Precipitants are a key reagent in crystallization as they decrease protein solubility, inducing the non-equilibrium state of supersaturation. Some of the most

commonly used precipitants for protein crystallization are polyethylene glycol (PEG) compounds, polymers made of the same monomer but differ in length. PEG 3350 is commonly used for protein crystallization, and it is also the active ingredient of the laxative MiraLAX. PEG 3350 for protein crystallization is generally purchased at a high price per gram from reagent companies like Hampton Research and Fisher Scientific due to its purity. However, due to how often PEG 3350 is used the cost of the reagent can greatly impact the overall cost of performing protein crystallization. Therefore, the purpose of this project is to determine if MiraLAX, which is more accessible and affordable than laboratory-grade PEG reagents, can be used as an alternative precipitant to form suitable protein crystals for X-ray crystallography. This will be done by crystallizing two proteins: Lysozyme and 6 Hydroxynicotinic Acid 3 Monooxygenase (NicC) utilizing MiraLAX, PEG 3350 from Hampton Research, and PEG 3350 from Sigma-Andrich as precipitant and comparing their results. The crystallization trays will be interpreted by looking at the presence or absence of crystals. If crystals are present, their size, shape, and quantity will be analyzed.

93. Nickel-Catalyzed Cross-Electrophile Coupling of Oxetanes

Benjamin Le, Advisor: Taylor Thane

Cross-electrophile coupling reactions are important for the formation of complex organic molecules. Here we report the development of a nickel-catalyzed cross-electrophile coupling reaction between oxetanes and aryl halides. This method includes the opening of the oxetane ring and the formation of new carbon-carbon bonds between the electrophile coupling partner and the oxetane ring. Oxetanes are crucial as they have high ring strain that allows for the ring to be susceptible to being opened. The use of a nickel catalyst is a better alternative than other precious metal catalysts due to its carbon footprint and abundance. The specific oxetane that is being formed is important as it is a model substrate for the development of the cross-electrophile coupling reactions that are being investigated.

94. Development of Nickel-Catalyzed Cross-Coupling Reactions of Azetidines

Berenice Fregoso, Advisor: Taylor Thane

Transition-metal catalyzed cross-coupling reactions are a common method for the formation of new C-C bonds. These reactions have been used to make synthetic substances such as plastics, fertilizers, and biologically active molecules. There is increased interest in the pharmaceutical industry to retire the environmentally and economically expensive practice of using precious metals like palladium as a catalyst. Nickel is a great alternative to palladium due to its abundance and cost compared to other transitional metals. Azetidines, the four-membered heterocyclic intermediates, are highly strained ring systems susceptible to ring opening reactions making them suitable coupling partners in cross-coupling reactions. We aim to develop a more sustainable approach by developing a nickel-catalyzed

cross-coupling reaction of azetidines. This details the synthesis of the azetidine precursor used for the nickel-catalyzed cross-coupling reaction.

95. Growth of 50v1 Acinetobacter Strain in Nutrient Rich Conditions

Brennan Ortega, Dominic Lopez, Advisor: Rakesh Mogul

Acinetobacter is a genus of bacteria commonly found in cleanroom environments such as spacecraft assembly facilities. These bacteria can survive in the abundant microbiome present, degrading several cleaning reagents designed to get rid of them. It is of vital importance to study how this specific bacterial genus can thrive in oligotrophic environments where carbon sources are limited, paving insight into their growth and survival in these conditions.

96. Synthesis and Probing CO2 Reduction with a Bidentate N-heterocyclic Carbene Nickel Complex: (mNH2mCF3PhNHC2Me)Ni(COD)

Claudia Wong, Advisor: Chantal Stieber

Carbon dioxide emissions continue to increase and the development of various methods to reduce CO2 are necessary. The goal of this research is to utilize catalysts to chemically reduce CO2 by synthesizing nickel(0) complexes and assessing reactivity with captured CO2 sources. Bidentate N-heterocyclic carbenes (NHC2) are strongly sigma donating ligands that are reported to coordinate with a range of transition metals. The ligand precursor, [mNH2mCF3PhNHC2Me][Br]2 was synthesized first by reacting a commercially available substituted imidazole (3-(4-methyl-1H-imidazol-1-yl)-5-(trifluoromethyl)aniline) with dibromomethane in toluene and refluxed, followed by 1H NMR characterization. [mNH2mCF3PhNHC2Me][Br]2, was then deprotonated with 2 equivalents of potassium bis(trimethylsilyl)amide (KHMDS) and coordinated with nickel by adding Ni(COD)2. The product, [mNH2mCF3PhNHC2Me]Ni(COD) with a methylene linker between the NHCs, will then be used to asses reactivity with CO2 and is currently in progress.

97. Synthesis of a Novel bis(imidazolium) Salt

Clayton Coe, Advisor: Chantal Stieber

N-heterocyclic carbene (NHC) ligands are a useful moiety for stable organometallic species due to their strong σ-donation ability, and therefore stability in an organometallic complex. Bis-(imidazolium) salts are a precursor to bidentate NHC ligands. Three potential imidazole derivatives were investigated for their ability to link together via a methylene bridge. These derivatives were then refluxed in toluene and methylene bromide for several days, which, by previous work, should allow the formation of a linked salt product. One novel bis-imidazolium salt with a methylene bridge is reported, and the syntheses of two other potential bis-imidazolium salts were attempted but were not successful. The novel salt has

been characterized by 1H NMR and 1H-COSY NMR spectroscopy. Although a low yield was obtained for the synthesis, it was proven possible, adding to the library of possible NHC ligands. Further research will consist of searching for more efficient reaction conditions, purification methods, and the synthesis of bidentate NHC transition metal complexes using this novel salt.

98. Synthesis of 1,1,3-Trisubstituted Cyclobutane-Containing Compound Library: Using Grignard reactions and Amide Coupling

Daniel Jaramillo, Christa Larino, Luke Blake, Chantal E. Stieber Advisor: Thomas J. Osberger

The development of the second generation of antibiotics and medicinal compounds is of growing concern. Novel small molecules with desirable properties and 3D shapes are in demand as part of the search for the next drugs. The chemical properties and steric rigidity of the cyclobutane ring are drawing extensive attention from medicinal chemists, and polysubstituted cyclobutanes are being implemented in newer medicinal compounds. The research conducted here is towards the development of a two-step synthetic route that employs Grignard and amide coupling reactions to create new 1,1,3-trisubstituted cyclobutane compounds. Based on early investigations and 1H NMR analysis the synthesis route successfully created new cyclobutane compounds that have potential medicinal properties. A library of 11 compounds was synthesized in stereochemically controlled fashion, and included alcohol, amide, alkyl, and aryl substituents around the cyclobutane core. This modular synthetic scheme has future capabilities of expanding the library of substituents by use of various Grignard & amine reagents, but more importantly, opens the door for biological testing and discovery of new small-molecule drugs.

99. Oxidation of an Advanced Metallic Alloy

Diego Ochoa, Vilupanur Ravi, Advisor: Vilupanur Ravi

One of the recent advances in metallurgy has been the discovery of multi-principal element alloys (MPEAs). In traditional alloys one metal constitutes the “base” or “matrix” and is the dominant constituent, while the other elements are present in smaller quantities. In these new alloys the alloying additions are present in significant quantities. In many cases, the relative amounts of the alloy constituents are equal, although that is not a necessary condition. A number of groups across the world are exploring different aspects of these types of alloys. Alloys are being considered for different applications; however, there are many unknowns that need to be investigated before they find widespread use. At Cal Poly Pomona, we are investigating the oxidation behavior of a specific MPEA. We will report on the macro and microstructures of this alloy, pre and post-oxidation. Examples of oxidation graphs - mass changes vs time at temperature - will be shown.

100. Quantum Dot Production for a New Class of Solar Cells

Dominick Hernandez, Advisor: Matt Capobianco

One major issue today is finding alternatives sources of energy to fossil fuels and creating clean and renewable energy sources. One method of creating clean and renewable energy that many are trying to harness is using collecting energy from the sun and turning it into usable energy. One method of harnessing this energy is by using a material called molybdenum disulfide (MoS2) a 2D material that shows promise as a photocatalysis, energy conversion, and storage. MoS2 quantum dots (QDs) are highly tunable and can be cheaply and easily made. One method of synthesis is a one-step synthesis method using 0.1009g of NaOH, 0.0622g of MoS2 powder, and 60mL of ethanol. Then combine all into a solution and heated the solution in the oven to 180 °C for 12 hours. Then producing a slightly yellow liquid with QD. We then allowed ethanol to evaporate and dissolved the QDs in water and then we measured emission spectra on both the ethanol and water solutions. With this research we hope to fabricate new solar cell using quantum dots, find the best synthesis method for size dependence (tunability), and continue to characterize QDs using X-ray diffractometer and Raman spectrometer.

101. Synthesis of Mesityl Imidazole and Mesityl Bis(imidazolium) Dibromide Salt as Ligand Precursors for Catalysts

Emily Pham, Advisor: Chantal Stieber

N-heterocyclic carbenes (NHCs) are common ligands that can be used to stabilize metal catalysts. They are typically generated from imidazole precursors and can be linked to form bis(imidazolium) salts. The bis(imidazolium) salts are precursors for bidentate NHC ligands that offer additional stability via the chelate effect. This work synthesized an imidazole and bis(imidazolium) salt, which were characterized by NMR.

102. Effect of Linker Modifications on Cis versus Trans C-F Activation with Bis-Bidentate N-heterocyclic Carbene Nickel Complexes

Ethan Chavarin, Advisor: Chantal Stieber

Fluorine plays a massive role in developing effective pharmaceutical drugs, however selectively fluorinating organic molecules is extremely challenging. A common route to installing fluorine involves C-F bond cleavage. C-F bonds are among the strongest bonds in organic chemistry, with a bond dissociation energy of at least 130 kcal/mol and are typically cleaved by second or third row transition metals. A more facile, sustainable, and less expensive approach for C-F activation may be in using base metal catalysts. Monodentate N-heterocyclic carbene (NHC) nickel complexes have been reported to undergo C-F activation, however bis-bidentate NHC (RNHC2R1; R, R1 = alkyl or aryl) analogs have not been reported. This work examines a novel series of RNHC2R1 nickel(0) complexes with varying R1 linkers to determine the effect of linker on C-F activation of hexafluorobenzene. Comparisons include a reference nickel(0) complex with two monodentate NHC ligands, and results show that low valent nickel NHC complexes easily break the C-F bond in C6F6 via

oxidative addition. Crystallographic and NMR characterization demonstrate that ligand design and denticity affect the cis versus trans orientation of the final product, with possibility for additional ligand C-H activation. Cross coupling, and mechanistic studies are in progress.

103. Effectiveness of argon in reducing oxidative effects in corrosion experiments
Ezequiel Jimenez, Vilupanur Ravi, Advisor: Vilupanur Ravi

Laboratory studies of high temperature corrosion for certain applications require low oxygen and low humidity environments. The establishment of such a capability is a non-trivial undertaking. The effect of flowing and static argon gas in reducing oxidation of several nickel-base alloys was examined. The alloys were maintained isothermally at a test temperature of relevance to corrosion studies. Experimental variables included gas purity, flow rate and time of exposure. Care was taken to minimize the time between the surface preparation of the alloys and the start of the experiments to ensure that a pristine metal surface was presented to the atmosphere under consideration. Post-test specimens were characterized using different techniques. The effect of variables such as gas flow rate, time of exposure and alloy type will be presented and discussed.

104. Characterization of copper electrode corrosion in CO2 Reduction
Frances Paredes, Zachary Carillo, Advisor: Chantal Stieber

Rising carbon emissions have sparked interest in developing a cyclic relationship with the carbon in the atmosphere by utilizing carbon from CO2 as a building block. One approach to reduce CO2 is through electrochemistry in conjunction with a supported catalyst. In this study, copper was investigated as an electrocatalyst using ammonium carbamate as source of captured CO2, and decomposition of the electrode was observed. The kinetics and mechanisms of electrode reduction under reducing conditions were probed using a spectroelectrochemical setup with UV-visible spectroscopy, and the copper speciation in solution was determined. This will impact the understanding of electrode corrosion and development of carbon capture and utilization systems, as well as provide insights toward long standing questions in electrochemistry regarding corrosion and speciation of corroded species in CO2 reduction.

105. Synthesis and Reactivity of N-Heterocyclic Carboxylate Metal Complexes with a CO2 Source
Gabriela Lopez, Advisor: Chantal Stieber

The increase in greenhouse gas emissions, mainly carbon dioxide (CO2), from burning fossil fuels is the leading cause of Earth's rising temperature, encouraging chemical reactions to further produce pollutants in the air. As a result, the reduction of CO2 from trees and other

environmental factors can no longer combat human emissions. To counteract the emissions, the overall goal is to advance the capture of CO2 to be able to convert it into useful products. In this study, synthetic catalysts and first-row transition metals such as Nickel are of interest. An approach involves N-heterocyclic carbenes (NHC) and their carboxylate forms because of their ability to readily form organometallic complexes. For this project so far, a bidentate N-heterocyclic carbene complex with nickel, (MesNHC2Me)Ni(COD)2, was synthesized and reacted with 1,3-Dimesityl-imidazolium-2-carboxylate to observe any potential reactivity with the CO2 source. Products were characterized using 1H NMR and H-1H COSY NMR. Results are currently being processed and reproduced to reduce impurities and unwanted activity. Obtaining results is significant for gaining further knowledge on the reactivity of the CO2 bound to NHCs with first-row transition metals.

106. Studies Toward the Synthesis of Macrocyclic Bisbenzyltetrahydroisoquinolines by Pictet-Spengler Cyclodimerization

George Hernandez, Advisor: Thomas J. Osberger

The constant evolution of pathogenic viruses worldwide has caused millions of deaths due to growing resistances to current treatments many of which have toxic side effects. The family of Bisbenzyltetrahydroisoquinolines (BBTHIQs), compounds found in plant natural products, has shown a wide array of bioactive effects against various viral and non-viral illnesses. Of note, members of the BBTHIQ family have been found to serve as potential treatment starting points against the parasitic-borne disease leishmaniasis. Investigation into the synthesis of BBIQs thus has potential for novel drug therapies to reduce toxic side effects and potential for increased drug metabolism and pharmacokinetic results in the prevention and treatment of leishmaniasis as well as other illnesses.

Though studies on these compounds and their synthesis have been conducted, an effective route for their total synthesis and use in drug discovery has not been advanced upon in recent years, and synthetic derivatives have not been widely studied. This study thus aims to find a pathway for the total synthesis of the core structure of the BBTHIQ Tiliageine through development and employment of modern organic synthesis and catalytic methods. We propose a short synthetic route to two linear cyclization precursors forming a key ‘head-to-head’ bi-aryl linkage, culminating in a planned Pictet-Spengler cyclodimerization not previously explored in the synthesis of BBTHIQs. To-date, we have accomplished several synthetic steps towards the preparation of our cyclization precursor molecules. The end goal of this study is to investigate the potential of these efficiently synthesized molecules as starting points for novel therapeutics.

107. Smartphone Colorimetry: Crystal Violet Analysis
An Inquiry-Based Kinetic Exploration of the Hydrolysis of CV Using a 3D Printed

Spectrometer; A Lab Experiment at Two Levels.
Israel Estrada, Advisor: Yan Liu

Even with the period during which the covid-19 pandemic necessitated remote learning now in the past, the need for alternatives to traditional experiments in the chemistry lab persists. In this work, a kinetic exploration of the hydrolysis reaction between sodium hydroxide (NaOH) and crystal violet (CV) is carried out in a laboratory experiment with varying levels of difficulty; a lower-division introductory level concerned with implementing foundational chemical concepts, and a more advanced upper-division level inquiry-based kinetic experiment. To remedy the aforementioned need for instrumental alternatives, this work makes use of a 3D printed “spectrometer” and ImageJ to process images taken using a smartphone instead of the more tried-and-true method of UV-Vis spectrometry. Said images are then processed using ImageJ to yield an “instrument response” that changes along with the analyte concentration. A variety of concepts are demonstrated in both experiments; chemical absorption, molar absorptivity, reaction rate, reaction order, integrated rate law, etc. with accuracy comparable to results provided by a UV-Vis spectrometer. Moreover, an inquiry-based approach to the kinetics of the hydrolysis reaction for crystal violet goes hand-in-hand with the learn-by-doing aspect of kinetics laboratory experiments.

108. CHARACTERIZATION OF BIDENTATE N-HETEROCYCLIC CARBENE NICKEL COMPLEXES AND LINKERS USING X-RAY DIFFRACTION
Jeanette Wolfarth, Advisor: Chantal E. Stieber

First row transition metals attached to N-heterocyclic carbene (NHC) ligands are of interest as catalysts for a variety of transformations, including in the selective synthesis of pharmaceuticals. NHCs have a five-membered ring that contains 3 carbon atoms and 2 nitrogen atoms, where one carbon atom is a carbene and can bind to a metal center. There are many examples of catalysts that have second- or third-row transition metals bound to NHC ligands, however examples with first-row transition metals are fewer. This work aims to structurally characterize NHC ligands and their precursors, which will inform catalyst design and understanding of catalytic transformations. Single crystal X-ray diffraction, or crystallography, was used to determine the 3-D atomic structure of imidazole precursors to NHCs and NHC nickel complexes. The method requires a single crystal to be grown of the target molecule, then X-ray data collection, followed by data integration, refinement, and structure determination. This allows atomic positions, bond lengths, and angles to be determined, allowing for a greater understanding of the catalyst pocket and potential for reactivity. In this work, the structures of several new imidazole and NHC nickel complexes are reported and have not been previously reported in the Cambridge Crystallographic Structural Database.

109. Synthesis of substituted cyclobutane-containing molecules with amide and amine functional groups

Kaitlin Paguio, Advisor: Thomas Osberger

Cyclobutanes are becoming increasingly prevalent in medicinal chemistry due to their unique characteristics. Some current medicines, like Cibinqo, contain cyclobutanes with amine and amide groups. There are also several amino cyclobutanes that are in preclinical and clinical trials, such as Fluciclovine (cancer) and Ropsacitinib (psoriasis), and a TNKS1 inhibitor (cancer). These compounds utilized the unique characteristics of cyclobutane including their rigid conformation, saturated ring, and prevent cis and trans isomerization.1,2 If used correctly, these characteristics can make a compound more potent, selective to the wanted active site, and have better pharmacokinetic properties.1 Studying the synthesis of cyclobutane derivatives and substituents can help identify which reactions provide a reproducible procedure, easily accessible materials, and a higher yield. Initial attempts aimed to make cis-amino cyclobutane by reductive amination, similar method to synthesizing Cibinqo. However, due to the low yield and the difficulty to isolate the product, a different method of synthesizing an amino cyclobutane was utilized using the Mitsunobu reaction. The Mitsunobu reaction produced good yields of a trans-amino cyclobutane. This product can be further modified to produce a family of substituted amino cyclobutanes suitable for future biological testing.

110. Development of Nickel-Catalyzed Ring Expansion

Katherine Barraza Hernandez, Advisor: Taylor Thane

Dicarbofunctionalization reactions are widely used in pharmaceutical research to produce a variety of complex medications. Palladium is the most common metal catalyst for these reactions, however, because it is a precious metal, it is very expensive and scarce. Nickel, on the other hand, is much more available and inexpensive. Nickel has also been the favored catalyst in dicarbofunctionalization reactions, and for this research proposal, we will attempt to perform a nickel catalyzed dicarbofunctionalization with azetidines. Because of the large amount of strain azetidine rings are under, they are more susceptible to ring opening reactions. To achieve this, we prepared 2-phenyl-1-tosyl-azetidine as our model starting material from an aziridine precursor. This poster details the synthesis of the azetidine starting material and initial optimization of the nickel catalyzed dicarbofunctionalization reaction.

111. Synthesis od Bisbenzyltetrahydroisoquinolines (BBTHIQs) As Potential Antimicrobial Agents

Kristie Quintero, Advisor: Thomas Osberger

Bisbenzyltetrahydroisoquinolines (BBTHIQs) are a category of biomolecules discovered from plants exhibiting medicinal properties. For this reason, we

investigate the chemical synthesis of these molecules and their derivatives in hopes to test and screen, observing their effectiveness. These biomolecules have yet to be synthesized in an efficient route. Tiliageine's chemical structure contains a diaryl ether, a key functional group found in BBTHIQ molecules, that if successfully constructed can be utilized for the synthesis of other BBTHIQ structures. Therefore, the purpose of this study is to synthesize the BBTHIQ Tiliageine core compound through organic and catalytic methods. We investigate a potential synthetic pathway forming the desired diaryl ether via a coupling reaction of two precursor compounds – Aryl Boronic Acid and Methyl-4-hydroxylphenyl acetate. This pair of compounds will undergo a Cham-Lam Coupling mediated by Copper (II), cleaving the Boronic acid and forming a bond to the phenol of Methyl-4-hydroxylphenyl acetate, giving rise to the diaryl ether. This coupling sets the stage for further synthesis to the complete BBTHIQ and subsequent biological testing.

112. Synthesis and characterization of MoS2 quantum dots for solar energy application
Kyle Yang, Advisor: Matt Capobianco

Molybdenum disulfide quantum dots (MoS2 QDs) have the potential to become an alternative to dye-photosensitizers in solar cells given their tunability and light absorption. The synthesis of MoS2 QDs in this work follows that of the hydrothermal solvothermal method, which is to then be characterized to determine its size, structure, and photoluminescent properties.

113. Comparison of Synthesis techniques for MoS2 Quantum Dots
Liam Sullivan, Advisor: Matt Capobianco

Two of the major issues facing humanity today are the efficient production of clean energy and the replenishment of clean water sources. These issues cannot be addressed without first optimizing the materials at our disposal. Due to previously documented photoluminescence and catalytic properties, we are investigating the synthesis and use of Molybdenum Disulfide quantum dots for the purposes of generating an effective solar cell, and for use in the degradation of organic pollutants. The use of a robust and cost effective synthesis for these MoS2 quantum dots would help advance our understanding of photophysical and photocatalytic systems, and may enhance the materials used for solar cells and pollutant degradation.

114. Synthesis of Alkene Chromophores and their Light Absorbing Properties
Lizette Martinez, Advisor: Thomas Osberger

The improvement of human health outcomes has been extensively studied over the years. Scientists and pharmacists are constantly searching for ways to alter or synthesize new molecules with medicinal potential that could save many lives in the future. As of recently,

cyclobutanes have become increasingly common in small-drug molecules, making methods for their construction an excellent candidate for further research. The main goal of this project is to synthesize visible light absorbing chromophores and characterize them using UV-Vis spectroscopy, to evaluate their use in cyclobutane forming reactions. If successful, this method would be safer, consume less energy, and would be much more practical than the traditional use of UV-light. The synthesis of two different alkene chromophores was explored via Wittig and HWE reactions. In the future, we hope to measure the UV-Vis spectra of these newly synthesized molecules and analyze their photochemical activity.

115. Molybdenum Catalyzed Deoxydehydration of Vicinal Diols

Lucy Alexandre, Jonathan Wagner, Binh T. Nguyen, Wei Chien Tang, Advisor: Alex John

Our dependence on fossil fuels for energy and platform chemicals has raised concerns for both the environment and its scarcity. Thus, we aim to utilize biomass as a renewable source of feedstock. Biomass proves a challenge, as it is highly oxygenated and difficult to transform into usable chemicals for our needs. A possible sustainable option to replace our dependence on petroleum for the chemical feedstock is the use of molybdenum-catalyzed deoxydehydration (DODH) reactions to reduce the highly oxygenated biomass into useful olefins. Through altering ligands with different substituents, the effects of electronic properties, steric hindrance, and backbone rigidity on catalytic performance were evaluated. Utilizing a bulky group on the ortho and para positions on the ligand has elevated rates compared to other groups. Similarly, semi-rigid backbones such as a cyclohexyl group afford similar results. A completely rigid backbone such as a phenyl backbone completely hinders the reaction. Lastly, electronic effects can play a pivotal role in reaction rates as electronically withdrawing groups help while electron donating groups hinder the reaction. With these findings, current work focuses on determining rate law parameters for the best-performing catalysts and comparing them to the unsubstituted catalyst. This presentation will cover how ligand effects influence reaction rate as well as yield of products. Initial observations about ongoing research into rate law parameters will also be covered.

116. The Stereocontrolled Synthesis of a Cyclobutane-Based Fragment Library

Luke Blake, Advisor: Thomas Osberger

Cyclobutane rings are important structural elements of small-molecule pharmaceuticals and other biologically active molecules. As bacteria continue to develop resistance to antibiotics resources will continue to deplete. This project aims to synthesize a library of cyclobutane containing molecules with the potential for biological activities and test them for antimicrobial activity. However, the synthesis of stereochemically defined cyclobutane compound collections remains a significant challenge, leading to cyclobutane structures being underrepresented in commercial compound collections. The cyclobutane-based fragment library started from 3-oxocyclobutane carboxylic acid then amide coupling was

performed followed by reduction reactions to construct a family of functionalized cyclobutane carboxamide compounds. The substitution of various functional groups to the cyclobutane allows for the careful incorporation of groups with potential biological properties such as 1-adamantylamine which is used to treat Parkinson's disease and influenza A. So far, a library of 13 cyclobutane carboxamide compounds has been synthesized and in future studies will be evaluated for antimicrobial properties.

117. Studies towards development of POC devices for detecting citrus fungicides and HLB using LFA and LAMP platforms

Xuyao Yuan, Paula Truong, Jocelyn Down,s Michelle Camarena-Villeda, Chandrika Ramadugu, Sean Liu

The pursuit of rapid testing has become a central focus of research, with methods like the Lateral Flow Assay (LFA) and Loop-Mediated Isothermal Amplification (LAMP) gaining prominence due to their inherent advantages in terms of speed, cost-effectiveness, and accessibility when compared to traditional techniques such as Enzyme-Linked Immunosorbent Assay (ELISA) and Western blot. In this study, our primary objective is to optimize conditions for both LFA and LAMP analysis methods. This optimization involves varying procedures and materials used in the fabrication of LFA strips and the testing conditions for both LFA and LAMP techniques. For LFA strips analyzing the analyte human IgG, three types of gold nanoparticles have been studied. We have determined that using 40-nm diameter DCNovation (DCN) colloidal gold nanoparticles with an optical density (OD) of 0.560 at 520 nm, at a pH of 9, in conjunction with a detector concentration of 6.25 ug/mL, yields the clearest results. Additionally, enhancing the capture bioreceptor on both the control and test lines and employing a thicker nitrocellulose (NC) membrane with slower flow velocity further improves result clarity. Target analyte concentrations ranging from 1.5 ug/mL to 6 ug/mL yield results, and 2.5 ug/mL products the best result. This research spans a wide spectrum of target analyte concentrations, providing a robust foundation for future investigations. Furthermore, our work lays the groundwork for exploring other antibodies and their applications in detecting synthetic fungicides such as imazalil and thiabendazole. In analyzing the analyte imazalil using LFA strips, our groundwork has successfully detected imazalil at a detector concentration of 6 ug/mL. The target analyte concentrations ranging from 1 to 12 all yielded clear results. Additionally, we employ LAMP techniques to enhance the detection of citrus huanglongbing (HLB), a citrus disease caused by bacteria C.Las via vector psyllids. The real-time analysis graph of residue vs. time is displayed by the BioRanger detection unit, offering a rapid and cost-effective method as the first step of determination. Positive samples with different titers (Ct22-Ct28) were detected and differentiated. We are going to further improve it for real field use.

118. Development of a Nickel-Catalyzed Ring Expansion of Oxetanes

Nathan Kusumoto, Advisor: Taylor Thane

Cross-coupling reactions allow for the formation of new C-C bonds. These reactions allow for efficient synthesis of complex molecules. Additionally, oxetanes, highly strained four membered rings, are found within biologically active compounds and are reactive intermediates due to their ability to undergo ring-opening reactions. This work details the development of a nickel catalyzed ring expansion reaction of oxetanes with cyclohexene.

119. Synthesis of a Light Absorbing Compound For Pharmaceutical Uses

Seraiah Kinslow, Advisor: Thomas Osberger

In today's society the discovery of new medicines is crucial to maintain global health and proactively address new threats to it. The synthesis and discovery of small organic molecules continues to be an important source of new medicines. Consequently, the exploration of new chemical reactivity can enable more efficient pharmaceutical production. We are interested in discovering new reactivity of compounds through their interactions with visible light, a field called photochemistry.

Herein, we report the synthesis of and photochemical studies on N-methyl-5-bromo-3-nitromethylideneoxindole (1). Starting from commercially available 5-bromoisatin, N-methylation proceeded in 63% yield and the structure was confirmed by NMR spectroscopy. This material was subjected to the Henry reaction to afford crude 1, which was purified and characterized by NMR and UV-Vis spectroscopy. The results of this work confirm previous studies and will provide the foundation for developing visible light-promoted photochemistry for the synthesis of novel pharmaceuticals.

120. Developing a Nickel-Catalyzed Cross-Coupling Reaction of Oxetanes with Boronic Acids

Serli Arakelians Gheshlagh, Advisor: Taylor Thane

The purpose of this project is to develop a nickel-catalyzed cross-coupling reaction of oxetanes with boronic acids. Oxetanes are invaluable intermediates due to their high propensity to undergo ring-opening reactions. Thus, new carbon-carbon bonds can be formed by opening the oxetane ring using nickel catalysis. This work examines the nickel-catalyzed cross-coupling or ring-opening reaction with (3-methoxyphenyl) boronic acid, (S-BINAP)NiCl2 and (bipy)NiCl2 catalysis.

121. Synthesis of Mesityl Imidazole & a Mesityl Bis(imidazolium) Dibromide Salt With a Xylylene Linker

Soroush Azizi, Advisor: Chantal Stieber

Global warming and climate change has been on the rise since there are increased human activities, such as burning of fossil fuels, factories producing new materials which burns up fossil fuels creating an increasing level of greenhouse gases in our atmosphere. Greenhouse gas (GHG) is any gas within the atmosphere that absorbs and re-emits heat, keeping the

planet's atmosphere warmer than it would be. The main GHG in Earth's atmosphere are water vapor, CO2, CH4, N2O and ozone, all occurring naturally within the atmosphere.2 Carbon dioxide (CO2) is one of most common GHG emitted by human activities, making a total of 65% of GHG emissions. CO2 is produced through fossil fuels as the primary source, and are emitted from direct human induced impacts on forestry, deforestation, land clearing and degradation of soil.1 It is necessary to reduce CO2 emissions to the Earth's atmosphere or develop methods to chemically reduce CO2, but understanding the relevant processes is difficult. Initial work by Caitlyn Cruz in the Stieber Lab investigated reduction of CO2 using bidentate N-heterocyclic carbene (NHC2) Ni(COD)2 complexes. The starting catalyst was characterized with Nuclear Magnetic Resonance (NMR) spectroscopy and crystallography, then tested with a captured CO2 source such ammonium carbamate to determine if the complex could reduce or bind CO2. Captured CO2 sources such as ammonium carbamate allow for CO2 reduction chemistry to be studied from a non-gaseous CO2 source, which simplifies the experiment.

122. Exploring Copper Mediated Synthesis of Diaryl Ethers

Tommy Truong, Advisor: Thomas Osberger

Diaryl ethers are compounds that can be found in natural products and organic compounds. The structure of a diaryl ether is comprised of two aromatic rings connected by an oxygen bridge. It has been found that some diaryl ethers exhibit biological properties such as anticancer, antiviral, antibacterial, and herbicidal. Compounds containing a diaryl ether substructure was found to increase nerve growth factor to stimulate neurite outgrowths from PC12D cells which may be an important factor in treating neurological disorders like Huntington's disease. PC12D cells synthesize, release, and store dopamine and norepinephrine. These natural compounds have potential applications in medicinal chemistry, agrochemistry, and material science. It is important to study these compounds to assess their biological properties and chemical properties in treating neurological disorders.

Previous works have used a Buchwald-Hartwig reaction with a palladium acetate catalyst to make diaryl ether compounds such as geferlin, a natural compound. Now Ullman reactions are more commonly used for the synthesis of these compounds. In this paper, we attempt the synthesis of diaryl ethers by a copper mediated Ullmann reaction. The synthesis of diaryl ethers in high yield remains a difficult challenge and warrants further research due to its widespread applications in chemistry. Starting from 3-(4-hydroxyphenol) propionic acid, a fisher esterification was performed to obtain a phenol starting material. A Williamson ether synthesis was performed on 2-bromophenol to obtain the aryl bromide starting material. Ullmann coupling reactions were carried out with these reagents under nitrogen gas atmosphere. We have succeeded in synthesizing diaryl ethers with copper (I) oxide with a product yield of 32%. The compound's identity was verified using NMR spectroscopy. Also, various copper catalysts will be explored, along with different bases and solvents.

123. Quantum Dot Synthesis for New Class of Solar Cells

Tyler Tarigo, Liam Sullivan, Frankie Contreras, Dominick Hernandez, Kyle Yang, Advisor: Matt Capobianco

With climate change, we need to tackle energy generation with renewable sources. We can address this by harvesting light from the sun through solar cells. We look to make a new class of solar cells by attaching MoS2 quantum dots (QDs). We will utilize MoS2 QDs since they have great photoluminescent properties, can be easily tuned electronically, and easy and cheap to make. There are multiple ways to make QDs, but the synthesis utilized in this project demonstrates them being built from the ground up. This was done by stirring molybdenyl acetylacetonate, thioglycolic acid sodium sulfide all in an 80 ml beaker. Which was then heated for an hour with continuous stirring. As the solution was being heated and stirred, it was made basic by addition of sodium hydroxide chips until the pH was ~11. After the solution was at the desired pH, it was then put into an autoclave which was then put into a furnace for 20+ hours at 200 °C. To confirm successful synthesis of QDs they will be characterized with different techniques. Using equipment such as the UV-Vis and Fluorescence, they can show specific peaks that correlate with the literature graphs to confirm or deny QDs have been made.

124. Effects of Thiohydroxamic Acid to act as HDAC6 Enzyme Selective Inhibitor

Valerie Chou, Advisor: Adaickapillai Mahendran

Histone deacetylase 6 (HDAC6) is a recognizable enzyme found in the proliferation of cancerous cells and if attended to and inhibited, can be a considerable target in cancer therapy. Current FDA approved, notable HDAC6 inhibitors (eg. SAHA, figure 1) contain hydroxamic acid functionality, but due to the acid's strong chelation properties, the drugs render to be non-selective and often toxic, presenting carcinogenic effects. With similarity in characteristics of thiohydroxamic acids to hydroxamic acids, the study aims to analyze the chelation properties and differences in effect of utilizing a compound containing thiohydroxamic acids as a selective inhibitor (eg. thio-HPOB, figure 2). Through synthesis of the molecule N-hydroxythiophene-2-carbothioamide, which contains a thiohydroxamic acid, the study aims to characterize and test the potential properties and binding interactions of the molecule. Using NMR and LC-MS techniques, further analysis of possible isomer configurations within each step of the synthesis is conducted. Further characterization of metal binding properties and interactions with ions are to be studied to address the selectiveness and interactions of thiohydroxamic acids to act as an HDAC6 enzyme selective inhibitor.

125. Characterization of corrosion products in electrochemical CO2 reduction by copper at -0.25 microamperes

Zachary Carillo, Edward Madrid Jr., Anisha Bharadwaj, Ma Luisa Jhorine Faller, Advisor: Chantal Stieber

The current world population sits at 8 billion people and is only increasing. Hence, a larger population is leading to an alarming rate of increasing amounts of carbon emissions on our planet coming from the burning of fuels for energy. Rising carbon emissions have sparked interest for chemists in developing methods to reduce carbon emissions and/or ways to recycle the carbon that is in the air. Our experiment, which uses a fairly new method, attempts to solve this problem through the use of electrochemistry. The experiment aims to find if a copper electrode corrodes which can possibly be utilized in a carbon dioxide reduction. We ran a total of 3 tests in this specific order: open circuit potential(OCP), cyclic voltammetry(CV), and bulk electrolysis(BE) for 2000 seconds/points at a current of -0.25 micro amperes. For all the tests, the electrode was submerged in a potassium hydroxide(KOH) solution. During bulk electrolysis, the electrode was submerged in KOH and ammonium carbamate was added into the vial with the electrode at 200 seconds. When the ammonium carbamate was added, the spike followed by a dip is shown in the graph. We are still in the process of conducting more experiments in an attempt to get the “perfect duck model”, which shows a dip followed by a spike on the graph that gives off the shape of a duck, hence the name.

126. Optimization of the synthesis of N-hydroxy-4-(2-[(2-hydroxyethyl)(phenyl)amino]-2 oxoethyl)benzamide (HPOB)

Julia Zazueta, Advisor: Adaickapillai Mahendran

N-hydroxy-4-(2-[(2-hydroxyethyl)(phenyl)amino]-2-oxoethyl)benzamide (HPOB) is a selective inhibitor for the histone deacetylase six (HDAC6). HDAC6 is one of the eleven zinc-dependent HDACs in humans. HPOB was first synthesized by the Breslow group at Columbia University to examine possible anticancer effects as a histone deacetylase inhibitor. The HPOB synthesis is a multistep process. The first step is synthesis of methyl-4-bromomethyl benzoate (M4BMB). Simple acid catalyzed esterification of 4-bromomethyl benzoic acid (4-BMBA) and methanol lead to an undesired substitution product. Therefore, the optimization of M4BMB ester synthesis was warranted. In the first method, 4-bromomethyl benzoic acid was converted to methyl ester. The first attempt utilizes H_2SO_4, sulfuric acid, as the catalyst for a Fischer esterification reaction with methanol. The second attempt employed pTsOH, p-Toluenesulfonic acid, as the catalyst. and the third attempt uses $SOCl_2$, thionyl chloride, to convert the acid to an acid chloride and then reacting with methanol. The yield of these attempts were 32%, 25%, and 78%, respectively. The second method at creating the desired compound, M4BMB, could be obtained from the radical bromination reaction of methyl p-toluate and N-bromosuccinimide (NBS), using AIBN as a catalyst, with chloroform as its solvent. The first attempt, using chloroform, resulted in a 34% yield of M4BMB. The same reaction was repeated using freshly distilled chloroform to obtain a higher yield. Our attempt to optimize the synthesis and characterization of M4BMB, using Nuclear Magnetic Resonance (NMR) spectroscopy, will be presented.

COMPUTER SCIENCE

127. Autonomous Driving-QCar

Abhishek Brijraj, Vishwakarma Nathan Wang Phong Trinh, Advisor: Yunsheng Wang

Autonomous vehicles are vehicles that are able navigate on their own with little to no human input. Thus, autonomous vehicles should be able to function similar to how we humans do. By interpreting data from sensors all around the vehicle to understand the surroundings around the vehicle and act accordingly.

128. Exploring Object-Based Interactions in Virtual Reality

Alan Le, Alex Machorro, Ava Vazquez, Advisor: Markus Eger

Virtual reality (VR) has opened the door for unique interactions not before possible in the context of a simple video game. Devices such as a mouse and keyboard or a controller provide user input in their own way, but remain limited for mimicking real-life interactions. The goal of this research project is to explore realistic physics interactions using virtual reality. To achieve this goal, we employed the use of the VR Interaction Framework (VRIF) to create interactable objects in the Unity game engine. Through this framework, we aim to develop a deeper understanding of how object-based interactions can be used to create a more immersive user experience in a way not possible without VR.

129. Tactical Espionage Kittens Meow Gear Solid

Alec Urbany, Tyler Jones, Ngoc Chau Nguyen, Aidan Sanders, Bill Li, Ethan Pan, Advisor: Markus Eger

Tactical Espionage Kittens Meow Gear Solid is both a homage and an exploration of the stealth action genre of gaming. Taking notes from other legendary games in this genre, Meow Gear Solid serves as a way to explore stealth from an immersive Virtual Reality perspective.

130. 3D Spatial Note-taking in Virtual Reality

Amir Mohideen Basheer Khan, Advisor: Markus Eger

This project describes the development of a novel virtual reality (VR) application designed for the Meta Quest 3 headset, aimed at enhancing brainstorming and note-taking through a three-dimensional spatial interface. Developed using Unity, this application allows users to create, arrange, and visually connect notes freely within a VR environment, employing intuitive gesture controls and spatial navigation. The

integration of real-time internet access and AI functionalities via ChatGPT enables users to augment their notes with dynamic content and intelligent insights, fostering a richer brainstorming session. This project addresses key technical challenges such as interface design in 3D spaces, performance optimization on standalone VR hardware, and data security concerns. Through its innovative use of VR technology, the application seeks to transform traditional brainstorming methods by providing a more natural and immersive way to organize and explore ideas, potentially leading to heightened creativity and problem-solving abilities in various professional and creative fields.

131. Toward Multilingual Recommendation - Understanding Multilingual User Preferences in the U.S. and Mexico

Bryan Orellana de la Cruz, Peter Nguyen, Advisor: Ben Steichen

Despite a growing multilingual population, online recommender systems do not support multilingual search recommendations, instead returning recommendations based on the language of the input. This project focuses on how users respond to multilingual article recommendations compared to monolingual recommendations and which they prefer. Using Amazon Mechanical Turk, Qualtrics, and Prolific, we designed surveys in which users would read an article and be shown two recommendation lists related to the article. One list would be monolingual based on the language of the article, while the other would be multilingual based on the language of the article and another language. The user would then choose which list they prefer. The content of the article and list were manually chosen based on different topics, and the study would be repeated to compare user responses based on the topics of the articles and the language of the article (English or Spanish). Early preliminary results from initial test surveys show that users mostly prefer monolingual recommendations, but there is a significant portion of users that prefer multilingual.

132. Mobility Scooter Safety Assessment Motion Data Processing and Mobile App Development

Chenrui Zhang, Melvin Gitbumrungsin, Justin Nguyen, Advisor: Tingting Chen

133. Brain Trust: Securing Privacy in EEG Authentication

Christopher Hernandez, Advisor: Mohammad Husain

A new approach to biometric authentication has begun to receive some attention in recent years: brainwaves. In this scheme, a user wears an electroencephalogram (EEG) recording device (e.g., a headset or an earpiece) before “logging in,” and the system records their brainwaves and analyzes them. However, this data can be used to infer personal information such as a user’s age, gender, neurological conditions, or general mental state. Therefore, mechanisms are needed for these systems to function without exposing a user’s privacy to potential threats. At the same time, any such mechanism

should avoid significantly reducing the authentication accuracy of the overall system. In order to explore solutions to this problem, several possible authentication schemes were tested. All models tested performed analysis on three minute recording sessions from the "Auditory evoked potential EEG-Biometric dataset," available on PhysioNet. The dataset included EEG readings from 20 participants using 4 electrodes at positions T7, F8, Cz, and P4, based on the international 10-20 system locations. The pre-processing and feature extraction approach was based on the "MusicID" journal article by Sooriyaarachchi et al., which similarly utilized an auditory stimuli focused dataset.

The following authentication techniques were then compared using the data: a baseline random forest model, a random forest model running with homomorphic encryption, a BioHash implementation, a fuzzy hash function (based on ssdeep), and a bloom filter template. The standard False Acceptance Rate (FAR) and False Rejection Rate (FRR) measures were combined into the Half Total Error Rate (HTER) metric, for simplified comparison. From the tests run, the baseline approach displayed a HTER of ~0.01, the encrypted version had a HTER of ~0.005, the Biohash scheme came to ~0.001, and the fuzzy hash function and bloom filter template techniques both measured ~0.1. These tests show that the homomorphic encryption and BioHash strategies appear to currently be more effective at balancing security with system usability. However, the fuzzy hash function and bloom filter template concepts appear to be relatively new to EEG-based biometric systems, so it is possible that future variations may be able to improve performance.

134. IGR: InterGalactic Ranger

Dhruvi Choksi, Carson Green, Vinh Pham, Jibriel Ustarz, Advisor: Markus Eger

We utilized Unity and C# to design an immersive VR experience, with a Player as lone Intergalactic Ranger tasked to cleaning Earth's cosmic mess. Our unique locomotion system allows the player to propel and swing between Hovering platforms. For a slower but more easily controllable movement. Player has a jetpack to fly seamlessly through the zero-gravity environments. The main gameplay revolves around collecting hazardous waste and depositing it at the core of space structure before time runs out.

135. Large Language Model (LLM) Integration with SPOT

Gregorius Avip, Viet Nguyen, Loc Nguyen, Gabriel Alfredo Siguenza, Advisor: Daisy Tang

Integration of SPOT with LLM opens up new possibilities for robotics, transforming how users can interact with and command robots in real-world settings. By leveraging the power of LLMs in combination with scripting, engineers can create a friendly and conversational interface for SPOT, while also addressing the broader implications of LLM-driven robotic agents in terms of safety, ethics, and compliance. The primary goal is to enable the robot to process and act on instructions provided in natural language

through voice recognition, making human-robot interactions more intuitive and versatile.

136. Improving 3D Scans with AI and More Data
Ian McCurry, Advisor: Hao Ji

Photogrammetry can be simply explained as taking pictures of a subject and getting reliable information from it. From aircraft or someone snapping pictures by hand, a lot of its advancement is in creating a 3D model. Because of that, it has been a prominent field for machine learning, as digital twins of real spaces can be used to create training data, making models more robust. In practice, applications of machine learning will need to accurately assess varying surroundings with limited input, where processing inputs may be beneficial. The goals of this study are to explore the entire pipeline for generating a photorealistic 3D model of a physical object from multiple photos and automate an AI masking solution, as well as to understand how image count impacts output.

137. CPP VR Lab: Tower Defense
Ian Norman, Katelyn Mijares, Michael Phu, Jesse Chu, Advisor: Markus Eger

A tower defense game built in VR where the goal is to defend your base using towers that you construct piece by piece.

138. Exploring the Impact of EEG Data Signal Fluctuations Based on the Time of Day
Jason Jones, Advisor: Mohammad Husain

This exploration delves into the intricate dynamics of the human brain by analyzing EEG data to examine the fluctuations band powers at different times of the day—specifically morning, midday, and night. The central objective is to elucidate the connections between our circadian rhythms—the internal processes that regulate the sleep-wake cycle—and neuronal activity. The aim is to highlight the existence of time-dependent fluctuations in EEG signal data. In doing so, we can ensure that the time-dependent fluctuations can be taken into consideration when conducting further studies. By leveraging the advanced sensing capabilities of the Emotiv EPOC X devices, the study captures the ebb and flow of brain activity that may correspond to the natural rhythms dictated by the time of day. Employing rigorous statistical methodologies that provide a comparative analysis of the mean band powers. These statistical tools pave the way for identifying not just variations but statistically significant differences that could suggest deeper biological underpinnings.

139. Real-Time Optical Navigation for Automated Library Services Using Mobile Robots

Joshua Estrada, Advisor: Yunsheng Wang

Mobile robots have the potential to automate several library management tasks, including book collection and return. When someone wants to check out a book, a mobile robot can be deployed to navigate to the book's location, identify the book on the shelf, and retrieve it. Similarly when a book is returned, the robot can navigate to the book's location and appropriately place it back on the shelf.

Libraries often utilize the Dewey Decimal Classification, where bookshelves are classified by subject and organized on shelves by title/author to easily locate them. Books are placed on the shelf so that the side (spine) of the book is visible, displaying the title/author of the book along with a tag that the library places on the book to uniquely identify it. However as books are looked at, checked out, and returned they can end up in the wrong place, making them difficult to find.

Likewise, autonomous vehicles deployed on public roads have the potential to increase the convenience, safety, and efficiency of transportation. Planning for autonomous vehicles is often organized as a hierarchical system. The navigation planner plans the vehicle's route within the road-network, the streets and roads needed to get from point A to point B. The global planner plans the path and behaviors that the vehicle needs to achieve the navigation plan at the lane level, how the vehicle should drive within the lanes to make turns onto the appropriate street. The global planner suggests a path that is then optimized by the local planner, planning an appropriately fast, efficient, and safe trajectory that the vehicle executes while avoiding collisions.

Autonomous vehicles often rely on GPS and preloaded high-definition maps to navigate. However much like books being out of order on a shelf, these high-definition maps are often incorrect or out of date and GPS can be unreliable under certain conditions, causing the vehicle to navigate to the wrong location. This contrasts with how human drivers operate, after planning their route they can navigate without GPS and execute it optically, reading street and building signs to reliably reach the correct location.

Applying this concept of optical navigation to mobile robots in the library services context can reveal useful insights that can be applied to autonomous vehicles. Reducing the dependency on GPS and high-definition maps, providing a redundancy when GPS and maps are unavailable, while being capable of more precise navigation instructions (ex. drop me off by the sign at the front of the building).

140. Balls, Bridges, and Buildings

Joshua Lai, Kien Nguyen, Aidan Sanders, Advisor: Markus Eger

Balls, Bridges, and Buildings is a virtual reality experience designed for the Meta Quest 2 headset and created using Unity. The purpose of the game is to test the player's structural engineering skills. Their goal is simple: to get a ball from one point of the level to another. To do so, they must build a free-standing structure and are provided with a collection of rails, support struts, and machines to do so. Once the player is satisfied with their creation, they may start the simulation. Support struts are designed to mimic real-life physics, and their joints will bend under weight or even break off if too much force is applied. Thus, players must consider how weight loads will be distributed on their structure.

141. Exploring Cybersecurity Vulnerabilities in IoT Devices
Julia Chaidez, Advisor: Mohammad Husain

An Internet of Things (IoT) device is any device that communicates through a wireless network. Examples include your phone, smartwatch, smart lightbulb, security camera, and even smart refrigerator. In recent years, the proliferation of IoT devices has surged due to consumer demand. They are highly attractive due to their potential to automate many daily tasks, making life more convenient and business operations more efficient, ultimately enhancing our lives. However, they remain vulnerable to cyberattacks. To investigate the potential vulnerabilities of IoT devices, I used a Raspberry Pi as the host for a simple website I created. Subsequently, I utilized a HackRF One to capture the WiFi signals exchanged between the Raspberry Pi and my PC. Using Wireshark, I demodulated and extracted the TCP/IP packets necessary for analysis. Through intercepting and analyzing these WiFi signals, I recognized the susceptibility of IoT devices to unauthorized access, highlighting the critical need for strong cybersecurity measures in a time of increased connectivity.

142. A Covert Channel in 802.11 via the RTS/CTS Mechanism
Kevin Kwik, Advisor: Mohammad Husain

Covert channels of communication in computers have been a continual area of research and provide a potential avenue through which data transfer may occur unseen, for reasons malicious or otherwise. The ubiquity of WiFi networks today make covert channels in network communications a particular hot spot of research and can provide a plethora of flexible and difficult to detect options. In 2008 a covert storage channel exploiting theRTS/CTS mechanism was proposed. This poster details an implementation of the proposed method along with recommendations for usage.

143. TicTacSPOT
Laurence Tremblay Vinh Pham Youstina Gerges Mandy Ly, Denise Thuong, Hailee Wheat
Advisor: Daisy Tang

Through this research, we explore SPOT's advanced mobility, and manipulation abilities to facilitate interaction with humans in the context of playing a simplistic game, Tic-Tac-Toe.

To achieve this, we have integrated object detection to identify personalized X-pieces, tailored specifically for SPOT for easy pickup. In addition, SPOT's arm is deployed to manipulate those pieces, ensuring seamless gameplay. Lastly, we use fiducial detection to not only locate the game board but also to comprehend the current state of the game.

Building on these accomplishments, we are striving to enhance user accessibility and enjoyment by improving gameplay mechanics. Overall, the act of playing Tic-Tac-Toe with SPOT serves as a way to investigate the potential of robotics in everyday life.

144. Spoty Guard

Iker Goni, Nick Triance, Matthew Paredes, Advisor: Daisy Tang

Boston Dynamics Spot robot is an advanced quadruped robot platform that has a wide variety of potential use cases, such as patrolling an area and collecting data. Many of these uses involve Spot interacting with Humans. This project explores a skeuomorphic approach to better understanding this interaction. In the context of a secure facility, we have added functionality to Spot to have Spot behave like a familiar guard dog for security and safety in various environments, helping to acclimate users with interacting with robots.

145. Utilizing Software Defined Radio to Execute Replay Attacks on Radio Devices

Matthew Plascencia, Advisor: Mohammad Husain

A plethora of devices in today's digital landscape utilize radio frequency (RF) signals to communicate. These RF signals can take the form of many standard frequencies, like 27 MHz and 2.4 GHz, to name a couple. These frequency types can also send very different types of control information. Being able to determine what type of signals a device emits is an
important task to the device's security. Knowledge of the signals can allow anyone with benign or malicious intentions to take control of the device. Our goal is to ultimately find the signals of
DJI Air series UAVs and control them without a controller."

146. Autonomous DonkeyCar Research

Michael Ly, Alex Sanna, Sebastian Cursaro, Nick Hoang, Darshil Sheth, Advisor: Yunsheng Wang

The DonkeyCar Project is an open-source DIY self-driving platform for small-scale cars. It is composed of two components, a high-level self-driving library written in Python, developed with a focus for enabling fast experimentation and easy contribution, and car hardware, equipped with a single-board computer and a camera to allow for its training. Our research aimed to configure teleoperation, calibrate controls, gather data, and train the DonkeyCar to navigate lanes. We overcame preliminary hurdles by re-installing a compatible version of Raspberry OS, enabling teleoperation through remote and web control to work seamlessly. Training the DonkeyCar involved utilizing OpenCV and TensorFlow to detect and maintain lanes on a 20-foot track. We plan to integrate edge computing via CHI@Edge, offloading Raspberry Pi computation for greater performance. Challenges in the initial setup underscored the importance of compatible operating systems. Our approach facilitated technical proficiency in systems programming and machine learning, laying a foundation for future studies into edge computing applications in autonomous vehicles. Looking ahead, our work paves the way for improved training methodologies and the exploration of edge computing within real-world infrastructure.

147. CPP VR lab: Cybersecurity training (Data Science Team)

Mohraiel Matta, Justin Ha, Erika J Ledesma, Advisor: Markus Eger

The Cybersecurity training VR game is a virtual reality simulation where the players are encouraged to study cybersecurity-related questions by playing a game inspired by wave-based shooters. We took the player data and analyzed it in many different ways to give the player a helpful analysis including their weakest and strongest categories according to the answers and how fast they were answered.

148. Language Learning AI Tutor Assistant App: LightTalk

Natasha Wong, Advisor: Yu Sun

LightTalk is an AI chatbot that lets users first specify information about themselves including the language they want to learn, their experience in the language, points for improvement, and their goals such as learning more vocabulary or improving reading. LightTalk provides suggestions on exercises that may aid them in their language-learning journey. Various learning topics such as conversation practice, reading comprehension, pronunciation practice, or vocabulary practice produce different types of exercises. The assistant receives feedback from the user on how easy or difficult they found the exercise to be and analyzes that data to assess the effectiveness of the chatbot and tailor improved responses for the user's skill level. To overcome barriers to language learning for people of all ages, this app allows learning resources to become more accessible, personalized, and empowering regardless of one's previous experience or background with language learning.

149. Evaluating Bias in Large Language Models

Tiffany Truong, Andrew Valdez, Allison Ly, Catalina Davis, Alex Machorro, Parth Singh, Xin Wang, Priyanshu Shekhar, Advisor: Markus Eger

Large Language Models use training data from a variety of internet sources. They are able to produce text by learning which words most likely appear together, as present in their training data. This results in text that amplifies any biases the input data might have. In this work, we are exploring how to measure and evaluate these biases, in particular biases that stem from racial and gender stereotypes. Being able to measure such biases is necessary to address them.

150. Harnessing the Crowd for privacy-enhanced Cloud Monitoring and Deployment

Priyatham Sai Chand, Advisor: Mingyan Xiao

As cloud computing continues to expand, the need for efficient and effective monitoring and deployment strategies becomes increasingly important. Traditional telemetry Collection methods rely on monitoring tools, which can be resource-intensive and does not preserve the privacy of its users. The operators do not prioritize the privacy of its users, creating a lack of trust. Crowdsourcing offers a promising alternative by leveraging the vast pool of potential data points available from user devices and applications.

The advantages of crowdsourcing telemetry data over conventional methods will be discussed in detail that forms the basis of this thesis for its data collection methods as well as preserving the privacy of the users and encouraging them to share data more confidently and in greater numbers. Various types of privacy-preserving mechanisms are debated based on their effectiveness and to ensure the privacy of user data that is collected. In this study, a framework for implementing crowdsourced cloud telemetry collection is proposed along with the considerations for attribution selection and privacy of the worker, though replacing identification information with pseudonym-based on hash functions. This framework addresses key considerations such as user data privacy and the performance of the application on worker devices. Additionally, it proposes a methodology for utilizing crowdsourced data for anomaly detection and optimized deployment strategies of the fixes that are produced to mitigate the issues that was summarized from the data.

Finally, the effectiveness of the proposed framework is evaluated through a series of methods and case studies. These demonstrate the ability to improve accuracy and coverage of cloud telemetry data and the privacy of the worker.

151. Programming a Procedurally Generated Dungeon Map Using Python
Scott Baroni, Avi Gonzalez-Carlos, Rogelio Flores, Advisor: Steve Alas

Procedural generation has been used in many videogames to create "randomly" designed levels and maps. However, these levels aren't completely random, but instead are random within certain limits. For our project, we decided to explore procedural generation using Python and produce our own "randomly" generated dungeons consisting of rooms and connecting hallways. To accomplish this, we specifically used Pygame and its functions to draw rectangles on the screen. We used a common method when it comes to procedural generation: generate the rooms first and then connect them. To generate the rooms, the screen was split into 12 quadrants, four columns and three rows. So, each room can be generated in a quadrant and won't overlap. The random part about the room generation is the size and location within the quadrant. Then we connected the rectangles (if they could be connected) vertically and horizontally. Which results in a complete dungeon on a grid that could be used for a video game or even a tabletop roleplaying game like Dungeons and Dragons.

GEOLOGICAL SCIENCES

152. Mapping Pisgah Crater Lava Fields with Drone Based Photogrammetry
Jason Bragg, Advisor: Nicholas Van Buer

The purpose of this project was to determine if drones could be used to map landscapes for geological study. We used a DJI M30 drone as well as a Matrice 300 RTK drone equipped with Zenmuse P1 sensor to map highly georeferenced aerial photos of lava flows near Pisgah Crater in the Mojave Desert. These photos were then put into Pix4Dmapper, which used photogrammetry to achieve 2-10 cm resolution point cloud data in color. A 3D model was also generated and 3D printed. These point clouds were then processed in ArcGIS Pro to find slopes and textures of flows in the mapped area. We found that flows with grades less than 2% resulted in smooth textures and that flows greater than 2.5% resulted in rough textures. These results were consistent with the current understanding of how the steepness of slopes affects texture. When we compared the generated results with real physical distances we mapped in the field, the maps were found to be geo-accurate and featured at max of 0.32% distortion. This is within the error of the physical measurement, meaning this is an acceptable amount of distortion. We found that drones can act as excellent tools for mapping geological landscapes. This project also led to a greater understanding of drone systems for future projects, especially in terms of data management and processing.

153. Albedo and Vegetation as Heat Mitigators for Vulnerable Populations
Sara Guerrero Velandia, Advisor: Sahar Derakhshan

Heat events in California are becoming more frequent, and correlations with health risks have been found considering the number of emergency room visits during these periods. It is a risk factor especially for those populations in more vulnerable conditions with limited access to cooling centers or other resources. Therefore, this study proposes to evaluate the implementation of surfaces with more albedo effect and abundance of vegetation to act as mitigation strategies focusing on Los Angeles County area.

154. Fault Trends of the San Dimas Canyon

Spencer Sabins, Jonathan Nourse, Advisor: Nicholas Van Buer

The San Dimas Canyon Fault (SDCF) is a stress accommodating or “tear” fault produced by the uplift of the San Gabriel Mountains. Several larger faults, such as the San Andreas, control the tectonic regime of the area. Recent earthquakes on the SDCF have prompted an investigative interest in the area in an effort to better constrain and understand the regional tectonic trends. Exposed striated fault surfaces, representing several separate generations of tectonic activity, provided a means by which to collect data and produce relevant computer models. Data points were collected by measuring the strike and dip of exposed surfaces as well as the trend and plunge of the striations using a Brunton compass. These data points were then compiled into Richard Allmendinger’s Faultkin 8 program to generate fault plane solution diagrams. The diagrams produced were consistent with known observations from around the San Gabriel Mountains and LA basin, further strengthening our understanding of regional tectonic development.

KINESIOLOGY AND HEALTH PROMOTION

155. Evaluating the Quality of Delivery and Participant Responsiveness: An OYO Study Update

Alejandra Lauren Castillo, Nasim Evyvazlou, Advisors: Lara Killick and Zakkoyya Lewis-Trammell

The older adult population has been rising rapidly worldwide (Wan et al., 2016). This has been accompanied by a lower quality of life due to declining physical capabilities (Chou et al., 2012). An innovative device, the OYO fitness gym, has the potential to provide an inclusive resistance training experience for older adults if the OYO exercise program is proven to be internally and externally valid (Clocksin et al., 2017; Lewis et al., 2023).

The goal of this study is to determine program fidelity. There are five pillars of fidelity we focused on two: quality of delivery & participant responsiveness.

156. Evaluating Participant Responsiveness: An OYO Study Update

Cody Antonio, Lynn Horiguchi, Advisors: Lara Killick and Zakkoyya Lewis-Trammell

The innovative OYO fitness gym device has the capacity to offer an inclusive resistance training experience for older adults, provided that the internal and external validity of the OYO exercise program is established. Our objective is to discuss participant responsiveness of the OYO program. To assess participant responsiveness, the session logs and system for observing fitness instruction time (SOFIT) were used on a group of participants completing the program at the local senior center. The session logs were used to take attendance of the participants by recording their names and the time they showed up. The SOFIT was used to determine the total time spent in seconds, the total time recorded in seconds, and the total number of intervals spent in moderate-to-vigorous physical activity. Our findings for the session logs show the total number of participants over the 8-week sessions. The attendance first started off stagnant with 5 participants going each session, however around week 5, we can see a decrease in attendance where we get an average of 3-4 participants. The SOFIT shows the total amount of participant's engagement in activity over time. The percentage of time spent in MVPA was 57.9%. These preliminary results suggest the participant's responsiveness to the program decreased over time. Factors that may have influenced the results could involve the instructor's effectiveness in demonstrating the exercises, and the participant's involvement in the program.

157. Exposure Dose and Adherence to Manual: An OYO Study Update

Kaitlin Gomez, Advisors: Zakkoyya Lewis-Trammell and Lara Killick

An innovative device, the OYO fitness gym, has the potential to provide an inclusive resistance training experience for older adults if the OYO exercise program is proven to be internally and externally valid. Our purpose is to report on exposure dose and adherence of the OYO program. To assess exposure dose and adherence, session logs and task/exercise checklists were used respectively on a group of elderly participants completing the program at a local senior center. These logs were used to track the number of participants during each meeting, whether at pre-/post-testing or actual exercise sessions. Meanwhile, the checklists were used to measure how closely the instructor followed the OYO curriculum. From the logs, we found that as the program progressed, attendance briefly increased, then decreased, remained mostly consistent, and finally decreased even more. The checklists showed that the instructor's completion of the tasks varied a lot throughout the program, but that they were mostly consistent in their completion of teaching the exercises, providing their name, and demonstrating them. These preliminary results suggest that, although participant retention gradually declined, the most integral parts of the OYO program were still primarily delivered according to its outlined instructions. As a result, it helps support the program's fidelity

overall.

158. Outcome of the Senior Fitness Test: An OYO Study Update
Olivia Banando, Lily Castorena, Advisors: Zakkoyya Lewis-Trammell and Lara Killick

An innovative device, the OYO fitness gym, has the potential to provide an inclusive resistance training experience for older adults if the OYO exercise program is proven to be internally and externally valid. Our purpose is to report on external validity of the OYO program. To assess external validity, the senior fitness test was used on a group of participants completing the program at the local senior center. The senior fitness test was used as a way to compare the average between the pre and post fitness tests. Our findings among the two participants show upper body exercise strength improved, while there was no change in flexibility, and a decline in lower body strength. It is important to note that the differences of these participants are descriptive and not statistically significant. These preliminary results suggest the OYO exercise program can improve the overall upper body strength amongst the participants who completed the OYO exercise program. These results are indicated based on the increased reps found in the post arm curl test as well as improved scores in the participant's post grip strength test.

159. Quality of Instructor Delivery: An OYO Study Update
Karen Callejas, Vincent Lord C. Sarino, Advisors: Lara Killick and Zakkoyya Lewis-Trammell

An innovative device, the OYO fitness gym, has the potential to provide an inclusive resistance training experience for older adults if the OYO exercise program is proven to be internally and externally valid. Our purpose is to report on the Quality of Delivery (QD) of the OYO program. To assess QD, we observed the use of Demonstrations, Instructor feedback, and Activity, Instruction, and Management (AIM) Analysis on a group of participants completing the program at the local senior center. The systematic observations were used to code information provided through video recordings of live OYO sessions. Demonstrations, Instructor Feedback, and AIM Analysis were observed and data was recorded concerning the live recordings. Our findings show that the instructor did not provide the expected number of demonstrations, preferred descriptive motivational instructor feedback over negative feedback, and negative feedback over positive feedback as well as checking for understanding. Our findings also show that the instructor demonstrated a significantly higher emphasis on activity over instruction and a higher emphasis on instruction over management. These preliminary results suggest that instructors of the OYO exercise program do not meet the expectations for quality delivery of the program.

MATHEMATICS AND STATISTICS

160. Tennis Prediction with a Markovian Approach

Alexander Kazmirchuk, Advisor: Manuchehr Aminian

A comprehensive analysis of tennis match prediction. Seeking to determine if a statistical model can more accurately evaluate player performance compared to existing public methods. We collected data on the 2021 and 2023 Wimbledon tournaments that would be used to inform
and assess our model. We developed a Markov chain model that integrates player momentum, enabling us to assess each player's likelihood of winning at every stage of the match. We use this todetermine at which points we can make confident assessments on the outcome of the match. Our model returns an accuracy of 80% when compiled over all set predictions of our 156-match dataset.

161. Steady-State Distributions of Generalized Birth-Death Chains

Heba Ayeda, Sean Kanne, Alex Kazmirchuk, Nhan Nguyen, Ashwin Rajesh Cassandra Serna Erika Vazquez, Joshua Ward, Advisor: Alan Krinik

Our research group studied the visualization of regions, R, of steady state distributions of generalized birth-death chains. This means that the real one-step transition matrix, P, have only transitions of size 0 or ± 1 and are somewhat stochastic, that is, each row of P sums to 1 even though an individual entry of P may be negative or greater than 1. These generalized birth-death chains produce a larger set of steady state distributions than the conventional birth-death Markov chains. The boundaries of our steady-state distributions R are determined by the eigenvalues of P. For simplicity, we restrict our consideration of generalized birth-death chains to have at most three states, where one-step transitions are functions of a or b. Even under these simplifying assumptions, we obtain an interesting variety of open, bounded and unbounded regions R that have conic section boundaries. Elements of R that have the same steady state distributions are geometrically identified as lying upon certain line segments within R.

162. The Evolutionary Game Theory: Behavior of players in Zero-sum Game

Hoyoung Lee, Advisor: Manuchehr Aminian

People make choices in playing games. In simple games like Rock-Paper-Scissors, each person has three options to choose from. If people are going to play games with multiple choices not only one time but multiple times, then in their best interest, they will seek the best strategy in that game. With a framework in game theory, we can express these quantities via payoff and strategy matrices, and we can try to find what strategy is the best for each game.

On the other hand, if people can individually change their strategies over a certain time to try to win more, and they do not know the payoff and strategy matrices, how will their selections evolve? We model this process by giving each player a strategy vector; a probability mass function of strategies to choose. A player can change their strategy vector over multiple ”Seasons,”

163. Visualizing Steady State Distributions of Generalized Birth-Death Chains in 3-Space

Sean Kanne, Heba Ayeda, David Beecher, Corey Bangi, Advisor: Alan Krinik

Birth-death chains are a form of Markov chain used in modeling within fields ranging from biology to systems engineering. We can simplify the computation of these chains by using a discrete time-step. Such chains can also be generalized by relaxing the restriction on their transition matrix so that it is somewhat stochastic, each rows entries sum to 1, guaranteeing the existence of the eigenvalue 1. Instead, we bound the eigenvalues to have absolute value less than one, enabling the use of Sylvester’s Formula to find the steady state as all terms proceed to zero as the exponent proceeds to infinity outside of the Frobenius Covariant of eigenvalue 1. This project sought to visualize in two and three dimensions the open regions, R, wherein these generalized discrete-time birth-death chains have steady state solutions. Under these assumptions we obtained a number of both bounded and unbounded 3-space regions and bounded 2-space regions for three and four state chains.

164. BEYOND NUMBERS: EXPLORING EMOTIONAL INTELLIGENCE IN SECONDARY MATHEMATICS EDUCATION

Ulises Adrian Castaneda-Hernandez, Advisor: Wayne Snyder

Studies regarding secondary mathematics education often focus on the IQ aspect of a student, such as their cognitive and intellectual skills. However, the importance of emotional intelligence and how it affects students within a secondary mathematics education classroom remain underexplored.

In this exploration, I plan to observe how secondary mathematics education students feel towards math education, understand and examine the anxiety levels a student might experience in a secondary mathematics education classroom, explore the relationship between students working individually or with a group and its connection to their levels of anxiety, and explore secondary mathematics education students' feelings towards their instructor's approach to the content and environment within the classroom.

PHYSICS AND ASTRONOMY

165. Space mission design concept project

Alejandro Martinez, Advisor: Shohreh Abdolrahimi

The Space Mission Concept Design project aims to create a simple process for planning future space missions. It uses a method called Model-Based Systems Engineering. The project starts by looking at the goals outlined in Science Decadal Surveys. Then, it categorizes these goals and figures out what measurements and tools are needed. Next, the science team works with engineers to set requirements for the mission's instruments based on these goals. The project's goal is to build a big database to help mission designers. They can use this database to make a list of requirements using a MATLAB model.

166. Surface Modification Using an In-House Atmospheric Cold Plasma Reactor

Diego Huerta, Silvi Petrosyan, Vincent Tran, Advisor: Nina Abramzon

Atmospheric cold plasma has numerous applications in the biomedical and manufacturing industries. Our project focuses on testing a helium based cold plasma reactor built in our lab with a high voltage (30kV max) power supply connected to electrodes surrounding the tube. The generation of plasma is tested by varying the power and flow rate to determine the optimal settings with our set to maximize Reactive Oxygen Species (ROS) present in the plasma. An optical emission spectrometer (OES) was used to identify spectral lines produced by the plasma which allowed for the confirmation of ROS such as hydroxide (OH) and atomic oxygen (O). Using the optimal settings metal coupons were treated and surface properties were studied using the contact angle technique. A relationship between contact angle versus treatment time was obtained. This demonstrates that our plasma source is a potential cost-effective alternative to commercial reactors.

167. Finding Mass-Loss Rates Using Stellar-Wind Bow Shocks: Converting IR Intensities into Gas Densities

Dylan Hope, William Salazar, Sydney C. Andrews, Alexander Larsen, Ryan J. McCrory, Julia R. Meredith, Alexandra C. Rosenthal Advisor: Matthew Povich

Infrared (IR) stellar-wind bow shocks are frequently observed to form near O- and B-type stars with a high relative velocity between the star and dusty, ambient interstellar medium (ISM). These objects provide a unique opportunity to measure stellar mass-loss rates, an important impacting stellar evolution and energy feedback to the ISM. Our

method for measuring mass-loss rates utilizes the geometry of the IR stellar-wind bow shock and balancing the momentum flux between stellar winds and surrounding interstellar material. We measure the intensity and estimate the depth in the sky for 33 IR stellar-wind bow shocks that are detected in both Herschel 70 µm images and either Spitzer/MIPS 24 µm or WISE 21 µm images. The IR intensity determined by these observations is converted into dust emissivity, from which we can estimate gas densities in the shock fronts using a Milky Way dust model. The driving O or B- type stars are all well-characterized by visible-light spectroscopy obtained using the Wyoming Infrared Observatory or Apache Point Observatory, and all have astrometric data from Gaia DR3. Effective temperatures of our target stars range from 15,000 K to 35,000 K, and surface gravities range from log g = 2.8 to 4.1. We highlight several individual examples drawn from our sample of stars with IR bow shocks to illustrate our observations and analysis methods.

168. Multivariate analysis of x-ray spectra from high-energy-density laser-produced plasmas

Eric Andrew, Advisor: Nina Abramzon

High-energy-density (HED) plasmas are hot, dense plasmas present in many areas of physics research including astrophysics, laser physics, and both magnetic and inertially confined fusion. These unique plasmas produce x-rays, the line-shapes of which can be analyzed via x-ray spectroscopy to provide insight into the conditions within the plasma serving as a vital diagnostic tool. HED plasmas can be created and analyzed in a laboratory setting, by focusing high-intensity lasers on targets that emit x-rays when laser-heated which are captured by Bragg crystal spectrometers. Using high repetition rate lasers allows us to pulse a laser more frequently, generating exponentially more high-resolution, spatially resolved spectra from these laser-heated targets than previously possible. The collection of large datasets in turn prompts the development of efficient algorithms to analyze and categorize the x-ray line shapes present in each shot of data to study the plasma conditions for each category of line-shapes. This can be achieved by adapting advanced data analysis techniques such as Principal Component Analysis (PCA) and Gaussian Mixture Modeling (GMM) for physics applications.

169. Fiber Optic Sensor to Measure Strain and Temperature

Jacob Siegersma, Ryan Read, Alejandro Beltran-Urrea, Shawn Chen, Advisor: Ertan Salik

Fiber optic sensors have found numerous applications in civil and biomedical engineering applications due to their immunity to electromagnetic interference, low cost , and capability for remote monitoring. We have investigated using a single mode - multi mode - single mode (SMS) sensor to measure temperature and strain simultaneously with a single probe. The spectral features from the SMS sensor shift in response to both temperature and strain, and by tracking multiple features one can

deduce both temperature and strain. When temperature is held constant, the relationship between the wavelength of a spectral peak and strain appears linear within our measured range (<540 microstrain), and similarly the relationship with temperature appears linear from 21-40 °C when strain is fixed. In our preliminary experiments when both parameters are allowed to vary, however, the overall relationship is found nonlinear possibly because of some coupling between temperature and strain. This coupled relationship evades a neat analytical method based on linear algebra to determine strain and temperature simultaneously. We believe that investigating stress directly rather than strain may be more appropriate because the sensor's natural length, and thus strain, varies with temperature, but more experimentation is still required.

170. Major Merger between a Classical Dwarf Irregular Galaxy and its Massive Ultra-Faint Satellite

Jonathan Rivas, Jeysen Flores-Velazquez, Advisor: Coral Wheeler

Dark matter, an elusive form of matter that does not emit nor interact with electromagnetic radiation, can be observed only through its gravitational influence on the visible matter in galaxies and the large-scale structure of the Universe. One of the best ways we can study dark matter is through the kinematics of dwarf galaxies, due to their high relative dark matter content. Dwarf galaxies are classified based on their low mass, with classical dwarf irregular galaxies having stellar masses typically around $〖10〗^5$–$〖10〗^8$ M⊙, and the even more dark matter-dominated "ultra-faint" galaxies having M* < $〖10〗^5$ M⊙. Because the stellar kinematics of dwarf galaxies is the best tool we have to model their dark matter content, any external influence on the stellar motion is also extremely important to model. Major mergers in dwarf galaxies (anything with at least a 1:10 mass ratio between the central and the satellite) can impact stellar kinematics in dwarf galaxies, and so properly predicting these effects has major implications for our understanding of dark matter and its role in shaping dwarf galaxy kinematics. We study one such major merger in a high-resolution cosmological Zoom-in simulation of a dwarf galaxy (M* ~ $〖10〗^6$ M⊙) merging with its massive ultra-faint satellite (M* ~ $〖10〗^5$ M⊙) using the FIRE-2 simulations (Hopkins et al. 2018). We perform mock observations of the simulation before, during, and after the merger, and make testable predictions for the line-of-sight velocity dispersion of classical dwarf irregular galaxies that may have undergone a similar collision. With these predictions, astronomers will be better equipped to disentangle the effects of dark matter and mergers on dwarf galaxies, allowing them to construct more accurate dark matter models.

171. Mechanical Properties of Supported lipid bilayer using Atomic Force Microscopy

Matthew Luna, Advisor: Krishna Sigdel

The nanomechanical properties of biological membranes play important roles in various processes such as vesicle fusion and fission. Functions of membrane proteins such as mechanosensitive ion channels are determined by the elastic properties of the complex lipid bilayer environment. Various techniques have been used to probe the mechanical properties of biological membranes. Among them, atomic force microscopy (AFM) has been popularly used to address fundamental questions on the mechanics of supported lipid bilayers. Here, we employed AFM-based force spectroscopy to determine Young's modulus of supported lipid bilayer made of E. coli polar lipids that mimic the bacterial membrane and POPC-supported lipid bilayer that mimics the eukaryotic cell membrane. Force maps that contain various force vs. separation distance curves were analyzed using a modified Hertz contact mechanics model to determine Young's modulus of the supported lipid bilayer.

172. Thermal Properties of Protostellar Envelopes Throughout the Galactic Center

Mina Thoresen H. Perry Hatchfield (JPL), Paul Goldsmith (JPL), Brian Svoboda (NRAO)
Advisor: Breanna Binder

There is a discrepancy in theoretical and measured star formation rates in the Milky Way's Central Molecular Zone (CMZ), as well as a shortage of comprehensive observational studies. This motivated the CMZoom survey, which observed dense material in the CMZ's 1.3mm dust continuum to identify and create a catalog of compact structures and cores that may be precursors to massive stars. CMZoom also identified a number of spectral lines that are known to be tracers of dense gas, shocks, and compact hot cores, all of which are indicators of star formation. This project presents an analysis of a triplet of upper level formaldehyde (CH2O) transitions taken by CMZoom at 218.5 GHz, 218.8 GHz, and 218.9 GHz for 280 sources. Formaldehyde is a good thermometer and densitometer for dense gas regions, which rarely have comprehensive and reliable measurements. We used the molecular transition modeling program Radex to generate density and temperature models of this gas and fit the spectra using a similar program called JADEX. We were able to determine the temperatures and densities of CH2O in these regions, which we compared to other CMZoom data. Preliminary findings indicate a large difference between CH2O gas temperatures and dust temperatures. We are currently investigating CH2O gas temperatures and spatial dependence and relation to star forming status and dust properties in an effort to understand the nature of star formation in the CMZ and shed some light on the discrepancy between theoretical and observational star formation rates.

173. Argon Plasma Treatment on Metal Organic Frameworks for Carbon Capture Technologies

Olivia Walsh, Silvi Petrosyan, Advisor: Nina Abramzon

Throughout recent centuries, technological advancement has led to an increasing issue in climate change, much of it due to carbon dioxide (CO2) emissions. It is imperative that CO2 emissions and atmospheric concentrations are reduced. Both Carbon Capture and Storage (CCS) and Direct Air Capture (DAC) have this potential, by capturing carbon at the emission source or directly removing it from the atmosphere, respectively. However, the widespread employment of these methods is limited by high costs and low efficiencies. Using materials with already high adsorption and separation ability could directly lower this cost. Metal-organic frameworks (MOFs) are crystalline compounds that are being explored for use in both CCS and DAC. Treating MOFs with plasma introduces a potential way to alter the material to improve its pollutant-adsorption abilities. For our research, we will first treat a type of MOF, UiO-66, with a commercial argon plasma reactor, then with a laboratory made plasma reactor. The MOF will be imaged using Atomic Force Microscopy and characterized by observing the color, wettability, and mass of the samples before and after treatment by each reactor. Gravimetric gas absorption analysis will be used to measure success of treatment. The experimental results will add to the communal understanding of the effects of cold plasma treatment on MOFs relating to carbon capture and, furthermore, may suggest a more cost effective and feasible method for MOF modification using a laboratory made plasma reactor.

174. High-Mass X-Ray Binary Formation in Nearby Galaxies

Rosalie Williams, Advisor: Breanna Binder

The population-wide properties and demographics of extragalactic X-ray binaries (XRBs) correlate with the star formation rates (SFRs), stellar masses (M*), and environmental factors of their host galaxy. Although there is evidence that XRB scaling relations (Lx/SFR for high-mass XRBs [HMXBs] and the Lx/Mstar for low mass XRBs [LMXBs]) may depend on metallicity and stellar age across large samples of XRB-hosting galaxies, disentangling the effects of metallicity and stellar age from stochastic effects, particularly on subgalactic scales, remains a challenge. We use archival X-ray though IR observations of eight nearby galaxies, self-consistently model the broadband spectral energy distribution and examine their XRB populations on subgalactic scales. We measure current star formation rate (0.013 to 1.042 Msol/yr), approximate stellar masses (0.242 - 56.885)x10^9 Msol, and metallicity gradients of the galaxies. We additionally correlate the radially resolved star formation histories with the observed properties of radially resolved XRB populations for four saubgalactic regions in each galaxy. When we compare the subgalactic Lx/SFR ratios as a function of metallicity to the galaxy-integrated Lx-SFR-Z relationships from the literature, we find that only the regions hosting the youngest HMXB agree with predictions, hinting at time evolution of the Lx-SFR-Z relationship.

175. Effect of CM15 on Lipid Bilayer Probed by Atomic Force Microscopy

Sophia Holland, Olivia Walsh, Advisor: Krishna Sigdel

Antimicrobial peptides (AMPs) play a crucial role in the innate immune systems of various organisms. AMPs interact with bacterial and mammalian cell membranes through various mechanisms, varying from nanopore formation to microscale membrane lysis process. The interactions between AMPs and cell membranes have been studied extensively through various biochemical assays. However, the mechanistic details behind membrane destabilization are still elusive. In this study, we used atomic force microscopy (AFM) to explore the effects of an AMP CM15 on a phosphatidylcholine (POPC) supported lipid bilayer. CM15 is a hybrid peptide composed of amino acid sequences of Cecropin-A and melittin, a peptide from bee venom. POPC lipid membranes are considered model mammalian cell membranes. Our study sheds light on how CM15 interacts with a supported lipid bilayer that mimics a eukaryotic cell membrane.

176. Investigation of Cold Plasma and its Effect on Surfaces

Vincent Tran Diego Huerta Silvi Petrosyan, Advisor: Nina Abramzon

Low temperature atmospheric plasma finds many uses in the sterilization and cleaning of materials in the biomedical field and the semiconductor, aerospace, automotive and electronics industries. The goal of this project is to determine the plasma parameters that are most effective at treating such surfaces by varying power, oxygen flowrate, and treatment time. In our research we use the Atomflo 600 commercial plasma reactor (SurfX Technologies) that utilizes argon and oxygen gas. An optical emission spectrometer was used to measure reactive oxygen species (ROS) such as hydroxide (OH) as a function of power and oxygen flowrate, maximizing ROS. Using optimized plasma parameters, stainless steel coupons are treated using an F4000N benchtop and analyzed using the contact angle technique. A relationship between contact angle and treatment time was obtained. We find that the optimal power and oxygen flowrate settings are 300W and 0.11 L/min respectively. The optimal treatment time for stainless steel is found to be between 10 and 15 seconds. Further avenues of exploration would include treatment of different materials and parameters and investigating contact angle as a function of distance.

177. Incorporating Gaia Visible-Light Photometry into Spectral Energy Distribution Modeling of Young Stellar Objects

William Salazar, Amethyst Johnson, Advisor: Matthew S. Povich

Concentrated near the midplane of our Milky Way Galaxy, the latest generation of stars born are known as young stellar objects (YSOs). These stars host disks comprised of gas and dust, primarily visible in the infrared. Studying disks yields insights about the

formation of planets, which helps us understand our own solar system. The Spitzer/IRAC Candidate YSO (SPICY) Catalog provides the most comprehensive list of YSOs in the Galactic plane currently available, complete with near- and mid-infrared photometry measurements covering the 1–8 μm range of the spectrum. Through the use of spectral energy distribution (SED) modeling, we can derive physical parameters of YSOs, such as luminosity, mass, and dust structure. Here we present a study of over 800 YSOs in the bright ionized nebulae NGC 6357 and NGC 6334, as well as NGC 6611 and G333. Further, 782 targets in NGC 6357 and NGC 6334, 520 targets in NGC 6611, and 1250 have well-fitted models. Of the YSOs in the target complexes, specifically NGC 6357 and NGC 6334, ~600 targets have available photometry from the Gaia DR3 catalog, with 579 stars having well-fitted models. The addition of the visible-light photometry better constrains model parameters sensitive to the short-wavelength end of the SEDs, particularly temperature and dust extinction. We also find that visible-light photometry influences the set of well-fit models available to interpret the longer-wavelength SEDs, enabling sharper distinctions between disk-dominated models and those incorporating infalling dust envelopes.

178. Superconducting Radiation Shielding for Low Earth Orbit Satellites

Jonathan Rivas, Ryan Chang, Justin Chrien, Matthew Roberts, Advisor: Nina Abramzon

Superconductive Radiation Shielding (SRS) is an up-and-coming project focusing on utilizing superconductors as a form of shielding against ionizing radiation to safeguard electronics. The project aims to explore this through laboratory experiments and COMSOL Multiphysics simulations. By analyzing data from both, the project seeks to optimize shield configurations by adjusting various parameters. The primary goal is to enhance protection for small electronics in environments with high-energy ionizing radiation. The research involves multiple on-campus laboratory and simulation experiments to determine optimal shielding configurations. Results are expected to be published within the first year of the project's completion.

179. X-ray Emission of Nearby Low-mass and Sun-like Stars with Directly Imageable Habitable Zones

Azariel Virgen, Advisor: Breanna Binder

Many low-mass and Sun-like stars host exoplanets within their habitable zones (HZ) that will be directly imageable to future observatories (such as the Habitable Worlds Observatory). The X-ray emission of these stars can make HZ-exoplanet with an atmosphere into a barren rock. Characterizing the X-ray spectra of the exoplanet host stars provides key inputs for modeling exoplanets such as atmospheric composition, stability, and climates.