

DISCOVERY

I5th Annual
College of Science Research Symposium

Friday, April 29, 2022

12 – 2 p.m.

University Quad

(in front of Building 8)

BIOLOGICAL SCIENCES

1. **Assessing the variation in gut length of Garibaldi, *Hypsypops rubicundus***

Daniel Aguilar*, Brenda E. Calderon Aceve, Chelsea M. Williams, Jacob L. Eagleton, Advisor: Jeremy Claisse

Garibaldi, *Hypsypops rubicundus*, are an omnivorous California native fish species typically found in the rocky subtidal zone. Garibaldi have year-around feeding territories, and during the spawning season males actively protect a nesting site within the territory. As part of an ongoing diet study in the Claisse Lab, gut length data is being collected but has yet to be analyzed. This study will investigate variation in gut length in Garibaldi between males and females and assess allometric relationships with body length. Garibaldi diet has also been shown to vary between artificial (breakwater) and natural rocky reefs so I will also investigate if gut length varies between these habitats. Additionally, I will compare Garibaldi gut lengths and allometric relationships to those found in the literature for other damselfish (Pomacentridae) species, as well as other marine fishes with different types of diets (e.g., herbivore, omnivore, carnivore). The length of the intestine typically related to diet type and in some fish species has been shown to vary in relationship to seasonal or environmental factors.

2. **Understanding developmental and molecular changes underlying floral organ abscission in *Aquilegia***

Ana Alcaraz Echeveste, Advisor: Bharti Sharma

While the flowers may be the most visually charismatic aspect of the plants, they are also highly complex. Using *Aquilegia coerulea* (Columbines) as a model system the proposed project goals are to understand 1) morphological and developmental changes underlying floral organ expansion and maturation 2) the genetic basis of organ maturation and identification of genes underlying the process of organ shedding or abscission in sepals and petals 3) the molecular and developmental changes in the gynoecium before and after pollination through seed set. We are using histology and scanning electron microscopy for developmental analysis. The developmental work will identify a) the timing of abscission zone (AZ) formation in showy sepals and petals and b) track morphological changes in the gynoecium as it matures. We are also conducting RNA-seq on sepals, petals, carpels, and ovules from critical stages identified through developmental studies. The transcriptomic dataset from sepals, petals, and receptacles will be used to identify the candidate genes that are involved in Abscission zone formation. The transcriptome data from the carpels and ovules will be used to understand the molecular changes in gynoecium pre and post-pollination.

3. **The Impact of Teaching about Patterns of Human Variation on Non-Biology Major Students' Views of Human Races**

Christian Aquino, Advisor: Paul Beardsley

Many Americans hold misconceptions that people from different socially constructed races have large genetic and phenotypic differences. In this study we assessed the impact of a scientific

curriculum on patterns of human diversity on undergraduate non-biology majors' understanding of the biological aspects of race and genetics. The subjects were enrolled in a virtual non-majors Life Science general education course during Fall semester 2021. Working with 3 faculty professors, subjects were assigned to a treatment (3 sections) or a control group (2 sections). Students in the treatment group completed a short human diversity interactive activity that used patterns of human diversity to address specific misconceptions. Students in a control section learned genetics as it is typically taught. All students in the study completed a pre-test (n=199) and an identical posttest which included questions to assess participants' confidence. Initial analysis of the pre-test data shows no significant baseline differences between the treatment group and control group. Data from the pre-test suggests that a higher percentage of students in this course hold misconceptions about patterns of human diversity than in other published work. For instance, 51% of students responded that there are individual traits that can be used to define a racial group (compared to 24%) and 70% (as opposed to 27%) think that there are more biological differences between racial groups than between individuals within a race. Nonetheless, the short lesson activity about the biological aspects of race and human variation was effective in increasing student understanding of human variation and how it relates to socially defined races ($p \ll 0.001$). Students not only increased their understanding, but they also greatly appreciated learning about human variation. However, there is still work to be done for students to fully understand key concepts about the biological (non)basis of race.

4. **Comparison of Sensitivities Between Two Antibody Based Devices for Rapid Detection of Salmonella Spp.**

Guadalupe Bernal, Jack Antich, Advisor: Wei-Jen Lin

Preventing the spread of food borne illnesses is done by preventative food testing and using traditional qPCR or PFGE which can be timely in comparison to rapid flow devices. In the food industry rapid antibody devices are critical to stop the spread of foodborne pathogens so development testing devices. There is no significant different in sensitivity between the commercial device (SinglePath) and the developing device (Biomedix) (T-test, $t = 0.47, p \text{ value} = .64$).

5. **Determining the role of neutrophil extracellular degranulation, mucosal antibodies, and lysosomes in the killing of Trichomonas vaginalis**

Suhani Bhakta, Advisor: Francie Mercer

Trichomonas vaginalis (Tv) is an obligate eukaryotic pathogen and the causative agent of trichomoniasis, the most common non-viral sexually transmitted infection. The immune response to Tv is not well characterized, however it is understood that neutrophils use trogocytosis, "to nibble," to kill Tv. Trogocytosis of Tv by neutrophils is contact and dose- dependent, however the molecular mechanism neutrophils use to trogocytose Tv has not been characterized. Using the CRISPR Cas9 RNP HDR editing, we will knockout a gene responsible for extracellular degranulation in neutrophils, *stxbp2*, to determine if the toxic granules aid in digesting Tv membrane before neutrophils can engulf the fragments. Additionally, we will knockout surface receptor Fc α R (CD89) from neutrophils using CRISPR Cas9 RNP HDR editing to determine if CD89 binds to IgA to initiate

trogocytosis. To determine if trogocytic bites of Tv are digested by neutrophil lysosomes, we inhibited lysosomes using inhibitors NH₄Cl and Concanamycin A. We hypothesize that extracellular degranulation is needed for neutrophils to form "bites" of trichomonads, CD89 bound to IgA will also facilitate trogocytosis, and the trogocytic bites of Tv are digested within lysosomes. Due to the short-lived nature of neutrophils, our experiments will be conducted using neutrophil-like cells (NLCs). To create knockouts in our NLCs, we designed and constructed RNP, HDR oligonucleotides for each gene and delivered them into the cell line via electroporation. Using the knockout NLCs, we will conduct cytolysis and trogocytosis assays with Tv to determine whether these neutrophil genes are needed to facilitate the trogocytic killing of Tv. To determine the requirement of lysosomes in the killing of Tv, we inhibited the NLC lysosomes using NH₄Cl and Concanamycin and co-culture the NLCs with Tv. These results will provide us with a better understanding of how neutrophils respond to the parasitic infection and how neutrophils function in general.

6. **Avian Community Shift over Seasons in an Urban-Agroecosystem**

Rachel E. Bockrath, Advisor: Elizabeth S.C. Scordato

Changes in human land use are contributing to the decline of global avian populations, and are reordering avian community structure across habitats. While studies have independently been conducted in the context of agricultural expansion and urbanization, we lack a clear understanding of how avian communities change across natural, urbanized, and agricultural habitats over seasons. Understanding how avian species use these diverse habitats will improve conservation and management decisions. To understand the changes in avian community composition across habitats and seasons, I am conducting point count surveys in the Santa Clara River Valley (SCRV) of Southern California. The SCR is a heterogeneous urban-agroecosystem that contains five major habitat types common throughout California: a restored riparian corridor, remnant coastal sage scrub, citrus and avocado orchards, suburban neighborhoods, and urban areas. My preliminary results indicate that each habitat hosts a unique avian community, but those communities change over seasons as some species are more flexible in their habitat use. This study will help reveal the changes in avian community composition over seasons in this heterogeneous urban-agroecosystem.

7. **Garlic's effects on lipopolysaccharide and lipoteichoic acid induced cytokine secretion in J774A.1 cells**

Megan Bradley*, Benjamin Zousel, Advisor: Nancy Buckley

Garlic has been used for centuries as a condiment and for medicinal purposes. Garlic is known to modulate the immune system. Important cells of the innate immune system include macrophages. The purpose of this project was to compare the effects of garlic on the secretion of tumor necrosis factor- α (TNF- α) from macrophages challenged with either lipopolysaccharide (LPS) or lipoteichoic acid (LTA). TNF- α is a pro-inflammatory cytokine and the major cytokine produced by macrophages. LPS is a component of the outer cell membrane of gram-negative bacteria, while LTA is a component of the cell wall in gram-positive bacteria. To investigate how garlic affects TNF- α secretion from LPS challenged macrophages vs those challenged with LTA, J774A.1 murine

macrophages were plated at 1.25×10^5 cells/mL. After incubating the cells for 24h at 37°C with 5% CO₂, the conditioned media was replaced with fresh media and the cells were treated with LPS (1 µg/mL) or LTA (0.5-1 µg/mL) in the absence or presence of varying concentrations of garlic. After another 24h incubation, we collected the cell supernatant and did an enzyme linked immunosorbent assay (ELISA) to measure the TNF-α secretion. To determine whether any of the treatments were toxic to the cells, we performed a protein assay and an XTT cell viability assay. Our results show that garlic treatment in the presence of LPS increases TNF-α secretion in J774A.1 cells when compared to control cells. Similarly, garlic treatment in the presence of LTA increases TNF-α secretion in J774A.1 cells. These findings suggest that garlic modulates TNF-α secretion from macrophages in response to bacterial molecules. The importance of our findings is that they could have relevance to emerging research in phytomedicine regarding the potential therapeutic effects of garlic in the prevention and/or treatment of infections.

8. SPATIAL AND HABITAT VARIATION IN DIET COMPOSITION AND ASSOCIATED LIFE HISTORY PATTERNS OF GARIBALDI (*HYPSPYPOPS RUBICUNDUS*) IN THE SOUTHERN CALIFORNIA BIGHT

Brenda E. Calderon, Chelsea M. Williams, Jacob L. Eagleton, Advisor: Jeremy Claisse

Life history patterns of marine fish species can vary across their geographic range. Although this variation is most often observed at large spatial scales, studies have demonstrated variability in growth, adult size, and reproduction across relatively small areas. Some of the proposed causal mechanisms include sea surface temperature, diet, inter- and intraspecific interactions, and size-selective fishing; however, the primary drivers are often unclear.

Along the California coast, the Southern California Bight (SCB) creates a dynamic environment with diverse bathymetry and a temperature gradient caused by contrasting currents. The SCB is home to Garibaldi (*Hypsypops rubicundus*), a pomacentrid marine fish discernable from other southern California reef species for its bright orange coloration and high territoriality. Both sexes of Garibaldi exhibit high site fidelity, defending permanent feeding territories of 10-15m² year-round. For mating males, these territories include a nesting site which is typically maintained by the same individual through consecutive breeding seasons. Garibaldi have benefited from state-wide protection from recreational and commercial fishing since 1995, when it was named the California State Marine fish. Their long lifespan compared to other reef fishes, high site fidelity, and non-fished status could make assessing their life history patterns a good way to comparatively measure habitat quality.

Garibaldi were collected between 2013 and 2019 from ten locations (5 island, 5 mainland) across the SCB. Previous projects in our lab found size frequency distribution and growth pattern differences by location, reef type (natural or artificial breakwater reef), and sex. Garibaldi grow larger and live longer in cooler locations and on artificial reefs and exhibit clear sexual dimorphism (males larger than females). Analyses of Garibaldi diet composition collected from the mainland locations showed significant variation in diet by location and reef type. In the present study, I plan to continue diet composition analysis by processing samples from island locations and combining this with the mainland diet data. Results from all studies will then be

analyzed to assess how spatial and habitat variation in diet is correlated with known life history patterns of Garibaldi in the SCB.

9. **Deletion of Tyrosine Hydroxylase in FoxP2-expressing Dopaminergic Neurons does not inhibit Food Anticipatory Activity**

Adriana Y. Castro*, Jacqueline R. Trzeciak, Advisor: Andrew D. Steele

Dopamine (DA) signaling has been found to be vital in circadian entrainment to food availability and the development of food anticipatory activity (FAA). FAA is characterized by high levels of locomotor activity preceding the scheduled meal time. While numerous experiments have failed to find a particular brain region that is responsible for circadian food entrainment, prior studies have indicated that DA signaling in the Dorsal Striatum act on D1R receptors to link mealtime to circadian activity cycles. To identify the DA neurons that control FAA, we conditionally deleted Tyrosine-hydroxylase (Th), a rate limiting enzyme for dopamine synthesis, with Cre recombinase targeted to the FoxP2 locus. While testing Th deletion in FoxP2-Cre loci, we found that mice with conditional knockout of Th had no impairment to FAA when compared to the wild-type. This observation suggests that the population of FoxP2-Cre expressing dopaminergic neurons are not required for FAA.

10. **Anatomical Response and Community Modeling of Quercus agrifolia to Low Atmospheric CO₂ Utilizing Material from The La Brea Tar Pits**

Matthew E. Cline, Edward Bobich, Regan Dunn, Frank Ewers, Advisor: Edward Bobich

The La Brea Tar Pits (Los Angeles, CA) was an active tar seep throughout the middle to late Pleistocene. These tar seeps trapped and preserved much of the local flora and fauna once found within the Los Angeles region. Fossils recovered at the La Brea Tar Pits can be used to infer the response to changes in past environments. Comparing these fossils to extant species can provide insight into the individual and community response to low atmospheric CO₂ and other climatic variables associated with glacial periods within the Pleistocene. Using plant material recovered from a packrat midden found at the La Brea Tar Pits (C14 ~46,000-47,000 y.a. ; Mychajliw et al., 2020) the anatomical response of *Quercus agrifolia* (coast live oak) to low atmospheric CO₂ is observed. Low atmospheric CO₂ functions as a selection pressure for plants as it reduces the rate at which carbon fixation can occur. Fossil samples provided by the La Brea Tar Pits are used in conjunction with live samples collected from field sites for direct comparison. Anatomical measurements such as stomatal size, density, and adaxial epidermal cell morphology are used to model and interpret the response to low atmospheric CO₂. Modern physiology measurements are collected to utilize in modeling of past physiologic response to the environment. In addition to these anatomical and physiologic measurements, modeling of canopy coverage as a response to low atmospheric CO₂ using Leaf Area Index (LAI) and modeling local atmospheric CO₂ using the Franks Model (Franks et al., 2014) are used to assess the community response and environmental conditions during the Late Pleistocene. Preliminary results indicates that low atmospheric CO₂ affects both the functional anatomy of individual trees and stands of *Q. agrifolia*.

11. T cell derived XCL1 facilitates the interaction with XCR1+ DCs within the CNS during WNV encephalitis

Kristen De La Torre, Advisor: Douglas Durrant

West Nile Virus (WNV) is a mosquito-borne flavivirus that causes encephalitis, especially in elderly and immunocompromised individuals. Previous studies have demonstrated that CNS-localized dendritic cells (DCs) protect against WNV neuroinvasive disease by establishing antiviral T cell responses in the CNS. In this study, we investigated the role of the XCL1-XCR1 interaction since its primary function is to promote DC-mediated CD8+ T cell immunity. XCR1, a chemokine receptor expressed predominately by a subset of DCs, mediates their migration in response to its ligand XCL1. We found that XCR1-deficient (XCR1^{-/-}) mice demonstrated increased symptomatic disease and mortality after subcutaneous infection with WNV. In addition, WNV-infected XCR1^{-/-} mice exhibited significantly increased viral burden in the CNS at day 12 post-infection. Within the WT CNS, we found increased XCL1 expression on day 6 post-infection. In contrast, the expression of its receptor, XCR1, increased on day 9 post-infection compared with uninfected CNS. As XCL1 is known to be produced by NK and CD8+ T cells, we next sought to determine which cells express XCL1 and at which locations during WNV encephalitis. Interestingly, compared with splenic T cells, CD8+ T cells isolated from the CNS and cervical lymph nodes from WT mice showed high XCL1 expression. These observations lead us to hypothesize that T cell-derived XCL1 facilitates interactions with XCR1+ DCs within the CNS during WNV encephalitis.

12. Identification and Classification of Gymnodoris sea slugs from New Caledonia

Jade De Souza-Canal, Advisor: Angel A. Valdés

On the coast of New Caledonia, the number of marine mollusk species recorded is much higher than in most other comparable areas on Earth. Moreover, islands like New Caledonia present extraordinary high levels of endemism, and the fauna is largely composed of rare species. Undescribed species still represent 80% of all the species present there.

The taxonomy of the nudibranch genus *Gymnodoris* (Mollusca, Gastropoda) is examined in this study, with specimens collected from New Caledonia that will be investigated with an integrative approach. This genus is composed of 30 known species, most of them being less than 2 cm in length, with yellow, orange and white colors. A total of 92 specimens of *Gymnodoris* and tissue samples are studied here, using dissecting microscopy and scanning electron microscopy for morphological descriptions; and DNA extraction and amplification, sequencing and phylogenetic trees for phylogenetic analysis.

The results from this taxonomic study will help broaden our knowledge and understanding of the evolution and diversification of the genus *Gymnodoris*. Studying the taxonomy of New Caledonia nudibranchs will provide insight on this region's endemism, and more generally, help unravel biogeographical patterns of marine endemism, as identifying undescribed species helps get better estimations of species richness and biodiversity.

13. Physiological ecology of two desert perennials along an elevational gradient in the Northwestern Sonoran Desert

John DiGildo*, Matthew Cline, Erin Questad, Frank Ewers, Edward Bobich, Advisor: Edward Bobich

The Sonoran Desert is the most speciose desert in North America. Plant distributions within this ecoregion rely on oscillating climatic conditions driving bimodal cool- and warm-season precipitation. In this study, physiological differences of two desert perennials, *Ambrosia dumosa* and *Encelia farinosa*, are being investigated along a topographic gradient at the University of California, Riverside Philip L. Boyd Deep Canyon Desert Research Center, during a period of extreme drought. Plants have been monitored since fall 2021 along 100 m transects at six elevations (sites) in the Deep Canyon watershed: three sites in the flood plain (two low elevation wash sites at 193 m and 240 m, and a site along a rocky slope at 286 m), a steep mid-elevation slope site (480 m), and two rocky high elevation north-facing slopes (Agave Hill at 818 m and Lookout Hill at 851 m). The physiological assessment of the species includes gas exchange, chlorophyll fluorescence, and predawn and midday water relations. Further, phenologic observations of the canopy and leaf characteristics, and flowering, as well as measurements of leaf area and mass, have been recorded. Finally, climate data (precipitation, temperature, and relative humidity) have been analyzed over the study period at three different elevations in the Deep Canyon watershed. Preliminary measurements reveal physiological differences along the topographic gradient; both *E. farinosa* and *A. dumosa* have higher water potentials, and greater CO₂ uptake and maximum quantum efficiency of photosystem II at the two highest elevations than they do in the flood plain and the mid-elevation site. This is in spite of the fact that the plants at the lower elevations are typically larger than they are at the higher elevations.

14. **Comparison of the Culturing Method and Antibody Base Rapid Test Device for the Detection of Environmental Listeria**

Liana Ab Samad, Diana Duenas Alejandre, Wei-Jen Lin, 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, including ready-to-eat meats, salads, and dairy products. *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 (1,2). Therefore, a reliable and efficient environmental *Listeria* monitoring method is essential for the compliance of the current food safety guidelines, as well as the protection for consumer safety. The standard culturing methods outlined in the USDA/FSIS MLG 8.11 and FDA BAM Chapter 10 involve two selective enrichment steps and the subsequent selective plating, requiring 5 days to obtain a negative result. The findings of our study show the REBEL Method with BioMedix *Listeria* Test Kit is statistically equivalent to the reference method when tested on any of the three surface materials. The REBEL Method with CHROMagar *Listeria* tested on tile surface also shows statistical equivalence to the reference method. The REBEL Method provides a reliable and easy-to-use alternative for detecting environmental *Listeria* spp. and results can be

obtained within 24 hours when screened by the BioMedix Listeria Test Kit and 48 hours when screened by the CHROMagar Listeria.

15. **The impact of small vertebrates on community assembly in degraded California sage scrub**

Taylor N. Edwards*, Erin J. Questad, Advisor: Erin J. Questad

Native consumers have been found to influence plant recruitment and community assembly, depending on what species they prefer. In California sage scrub, little is known about the preferences of small vertebrate consumers, although their feeding behavior may affect interspecific competition between native and invasive plant species. Moreover, there is an unexplored opportunity to investigate which plant functional traits are preferred by small herbivores in the sage scrub community. We established caged and uncaged native restoration plots in degraded sage scrub in order to investigate the effects of consumers on community assembly. Thirteen native species were hand-seeded into research plots dominated by invasive grasses and forbs. Three community types were created using different seed treatments (dominated by a preferred species (*Stipa pulchra*), dominated by a less preferred species (*Salvia mellifera*), or control with species included in equal abundance). Plant recruitment and growth were monitored in experimental communities while motion activated trail cameras recorded consumer activity. Preliminary results showed that both native and invasive species grew better in caged conditions compared to uncaged. Consumers appeared to prefer native over invasive species. For example, the recruitment of two nitrogen-fixing native annuals with the largest seeds (*Lupinus hirsutissimus* and *Lupinus bicolor*) was limited to caged plots only. Camera evidence revealed a strong presence of granivorous birds after seeding. Research plots were most frequently visited by *Melospiza crissalis* (California towhee), *Zonotrichia leucophrys* (white-crowned sparrow), and *Sylvilagus audubonii* (desert cottontail) in the weeks following seed addition. Continued data collection through the spring season will yield results on overall community and functional composition. So far, results suggest a notable influence of small granivores and herbivores on sage scrub community assembly, which may have implications for the success of native restoration.

16. **Anthropogenic Impacts on Population Distribution and Suitable Habitat of Welcome Swallows (*Hirundo neoxena*)**

Alexis Garvin, Advisor: Elizabeth Scordato

Human land use has risen steadily over the last several thousand years, but the long term effects of human land use change on demographic processes of other organisms are largely unknown. The welcome swallow (*Hirundo neoxena*) is an insectivorous bird found throughout Australia and nearby islands. Welcome swallows build their nests on man-made structures such bridges and buildings. An increase in human land use has likely provided them with more nesting habitat, which may have lead to an increase in population size over time. This commensal relationship with humans makes the Welcome swallow an ideal system to study the effects of long-term human activity on species distributions. In this study I am assessing the effects of longer-term human activity on the distribution of the welcome swallow using sighting records from eBird and species distribution models implemented through the maxent package in R. Species distribution models

(SDMs) estimate the relationship between observed species occurrences and the spatial characteristics of the locations they occupy to produce predictive models that allow us to assess changes in available habitat over time. Our data will provide crucial information on how anthropogenic factors play a role in the demographic changes of this commensal species as a result of long-term human landscape alteration.

17. **Herbivory of Native and Non-native California Sage Scrub Vegetation**

Alyssa L. Goldpenny, Taylor N. Edwards, Erin J. Questad, Advisor: Erin J. Questad

It is only in the last several years that herbivory within the endangered California sage scrub ecosystem has been more closely studied. Prior studies that exist have shown that herbivores prefer native species and avoid non-native invasive species in some ecosystems. We examined small herbivore (Desert Cottontail, California Towhee, White-Crowned Sparrow, etc.) predation levels on both native and non-native plant species that occur in the sage scrub ecosystem. Species included *Amsinckia intermedia*, *Clarkia purpurea*, *Lupinus bicolor*, *Salvia mellifera*, and *Stipa pulchra* for the natives, and *Bromus diandrus*, *Centaurea melitensis* and *Hirschfeldia incana* for the non-native invasives. The experiment utilized five plots located in the Voorhis Ecological Reserve where seedlings were planted and observed over ten days. It was found that by far, two native species were favored, specifically *A. intermedia* and *L. bicolor*, while the other three were avoided, along with the three non-natives. Specifically, *L. bicolor* is a known nitrogen fixer, and this could be a large part of why this species was favored so heavily. This leads us to our first area of future study, focusing on the nitrogen and carbon content of each species, in the hopes of uncovering a pattern between chemical composition and herbivory preference/avoidance. Our second area involves mining footage from wildlife cameras set up at each block to gather data on which specific small herbivore species are behind both herbivory in general as well as specific species predation. With this study, we show that native plant species are favored over non-native species, giving future restoration projects of these sage scrub ecosystems a solid direction to go in. From what we've found, restoration projects should focus on these three avoided species of native vegetation, as these will have a higher chance of surviving in the natural ecosystem when outplanted.

18. **Verifying A Genetic System Created For STIV3**

Addyson E. Hebbert, Advisor: Jamie C. Snyder

Viruses that infect prokaryotes and eukaryotes have received extensive research throughout the past century. One area of research that is currently lacking is our understanding of archaeal viruses. When compared with prokaryotic and eukaryotic viruses, the overall knowledge of archaeal viruses is very minimal. *Sulfolobus Turreted Icosahedral Virus 3 (STIV3)* was discovered within a hot spring in Yellowstone National Park. The host cell, *Sulfolobus Acidocaldarius*, grows at high temperature of around 80°C and an acidic pH of approximately 3. These growing conditions can be easily replicated in a laboratory setting making this an ideal archaeal virus to conduct research on. Due to the relatively large size of the STIV3 genome a genetic system was created that allows for easier genetic manipulation. Through this subclone system the full-length viral genome is split into five smaller subclones allowing for a more viable form to be researched. The

goal of my project is to verify that this subclone system is feasible by conducting mutagenesis of the subclones and observing changes of the host cell phenotype. Testing of the host cell phenotype will be performed by mechanisms which include, but not limited to qPCR, western blots, plaque assays, and imaging.

19. **Effects of Alternative Liposomal Amphotericin B Treatment Regimen on Pulmonary Aspergillosis in Metabolically Normal Mice**

Diego Henriquez, Jon Olson, Nancy Buckley, Advisor: Nancy Buckley

Obesity in the United States has reached an all-time high. Nationwide 44.2% of adults are considered obese (BMI >30), and this often is closely correlated to a high incidence of type 2 diabetes (T2DM). It is known that these kinds of immunocompromised individuals result in a lowered ability to resist infection and maintain a heightened level of basal inflammation. These conditions result in an increased susceptibility to infections of all kinds, particularly respiratory infections. The most common respiratory mold infection in humans is known as pulmonary aspergillosis and is most commonly caused by *Aspergillus fumigatus*. Currently patients suffering from this type of infection must undergo 14 days of intravenous treatment of Liposomal Amphotericin B (AmBisome®) in a hospital setting. Although the overall question involves what contribution the metabolic status of the host might have on the distribution of drug throughout the body, the goal of this portion of the study was to determine if alternative treatment regimens are equally effective in clearing severe pulmonary aspergillosis from otherwise healthy mice.

In this study the 10-week old male ICR mice were sedated and infected intranasally with 5.7×10^6 *A. fumigatus* spores and divided into three main groups, the control mice, non-intermittent and intermittently AmBisome-treated mice. The control mice were given intravenous 5% dextrose solution (D5W) daily for seven days and the remaining mice were treated intravenously with 5mg/kg of AmBisome daily for seven days. The non-intermittent group received no further treatment after those seven days. The intermittent treatment groups of mice were treated three times a week with 5 mg/kg of AmBisome intravenously for either one week, two weeks or three weeks. Tissues (heart, lungs, kidney, spleen, pancreas, kidney, fat, feces and brain) were collected on days 1, 8, 15, 22 and 29. To date, only the lungs have been processed and the effectiveness of the various AmBisome® treatment regimens were assessed based on the fungal burden measured in the lungs of each mouse. While more work is needed to analyze the drug concentration in the lungs, the fungal burden present shows that the mice that received AmBisome® treatment were less sick during the acute phase of infection and were able to regain almost normal weight levels. While the control mice were unable to regain their previous weight, mice treated with any regimen of AmBisome® had statistically similar we

20. **TO BE CRYPTIC OR NOT: WHAT DNA SEQUENCING REVEALS**

Julie Innabi, Advisor: Angel Valdes

Many sea slugs have been identified and classified under certain traits. Phylogenetics and dissections can allow us to re-address classifications of sea slugs and attempt to support or re-evaluate those classifications. In this study, I resolve the relationship between cryptic species

using molecular phylogenies. The genera *Atagama*, *Sclerodoris*, *Rostanga*, and *Jorunna nudibranchs* are poorly researched nudibranch groups for cryptic species. This study uses genetic analysis to identify obtained specimens from New Caledonia and any cryptic species in the samples. Lastly, this study uses information on reproductive and digestive structures to further support identification in addition to genetic analysis.

21. **Exploring Movement Behavior in Association with Lead Exposure in Turkey Vultures (*Carthartes aura*)**

Alec Christian Iskenderian, Alexandria Koedel, Peter Bloom, Miguel Saggese, Advisor: Andrea Bonisoli-Alquati

Exploring components of flight behavior such as speed and trajectory after heavy metals exposure can reveal the potential impacts of these pollutants on the health of migratory species. Scavenging birds are essential to ecosystems because they remove carcasses, limiting disease spread. Exposure to lead through a diet of animals killed by lead ammunition poses ecotoxicological and mortality risks to scavenging animals. However, the consequences of lead exposure for migratory behavior have never been tested. Here I compile and analyze tracking data from migrating Turkey Vultures (*Cathartes aura*), in association with information about their lead exposure from feathers and blood samples. I anticipate that lead toxicity to the physiology and brain function of these migratory Turkey Vultures might lead to impaired flight performance. I will analyze vulture flight tracks collected since 2021 using GPS units from two Turkey Vultures during their spring and fall migration. Movement of the migratory Turkey Vultures will be visualized with DYNAMOvis, a software for mapping and visualization of movement data. By combining data about lead exposure and tracking I will test the idea that lead exposure can have detrimental effects on vultures' flight behavior. Aspects of flight behavior that may be changed are the time intervals between flights, and how efficiently vultures use wind currents and landscape features for soaring. If flight behavior is changed, these results may act as a reference point for larger scale studies of altered flight behavior in this and other raptor species, highlighting the need for reduction of lead exposure to conserve wildlife.

22. **HOW MUCH SEED DO WE NEED? SUCCESS OF VARIED SEEDING DENSITIES AND WATERING EFFORTS ON SOUTHERN CALIFORNIA SHRUBLAND RESTORATION IN PLASTIC TREE SHELTERS**

Meghan A. Jeffus, Advisor: Erin J. Questad

Southern California shrubland communities face expansive type conversion into invasive grasslands, largely due to modification into livestock rangeland, high frequency of intense fires, and changing precipitation events. Unpredictable precipitation can make restoration difficult. A solution is to add water manually as part of the restoration; though the associated costs may prove unfeasible in large-scale projects. In addition, native species are outcompeted by intense propagule pressure from invasive seeds in the seed bank, which can be remedied in a restoration project by increasing the density of seeded natives. Seeding shrub species directly into plastic tree-shelters is relatively novel but has been shown to increase plant survival, height, and volume by providing favorable conditions for seedlings. This study will use a field experiment where seeds are added to tree shelters to test the effects of seed density and watering on plant growth and

establishment. By removing the unpredictability of precipitation with watering, we predict there will be higher levels of establishment at lower seeding densities, reducing the amount of seed needed for successful restoration. The proposed experimental restoration field experiment will occur at the John T. Lyle Center for Regenerative Studies at Cal Poly Pomona. *Diplacus longiflorus*, *Amsinckia intermedia*, and *Eriogonum fasciculatum*, three species commonly utilized in restorations, will be seeded into tree shelters at five varied densities of 10, 25, 50, 100, or 200 seeds per shelter. Half of the individual tree shelters will be given water on a biweekly basis for four months following establishment, with watering continuing for the first two years at larger intervals. To measure the success of the restoration treatments, presence and number of seedlings, germination rate, plant canopy area, and flowering timing and proportion will be recorded. Material and labor costs will be recorded for each treatment. This study aims to quantify the effect of watering treatment on the number of seeds necessary for a successful restoration without a surplus of wasted resources and costs.

23. **Correlation Between Adipocyte Nuclear Area and Lipid Accumulation**

Cristian Jimenez, Mona Ghou, Zachary Skovgaard, Yuanxiang (Ansel) Zhao, Advisor: Yuanxiang (Ansel) Zhao

Adipogenesis is the process of uncommitted human mesenchymal stem cells (hMSCs) differentiating into adipocytes. hMSCs can be stimulated to differentiate into adipocytes in vitro using adipogenic induction media (AIM) composed of insulin, dexamethasone, and 3-isobutyl-1-methylxanthine (IBMX). Our study aimed to determine how the nuclear area changes for both adipocytes and non-adipocytes over 60 days of adipogenesis and how lipid accumulation correlates with the adipocyte nuclear area over the same time period. DAPI and Oil-Red-O stains were used to identify the nucleus and lipid droplets, respectively, at specific time points over 60 days. ImageJ software was used to quantify the nuclear and lipid droplet area. The nuclear area was found to be significantly reduced in adipocytes compared to non-adipocytes at all time point measurements. Lipid droplet size was found to both increase continuously and negatively correlate with adipocyte nuclear area.

24. **Genetic Signatures of Selection for Resistance to Lead Exposure in the Turkey Vulture (*Cathartes aura*) Genome**

Alexandria Koedel, Alexandra Gresham, Peter Bloom, Miguel Saggese, Allison Shultz, Advisor: Andrea Bonisoli-Alquati

Turkey Vultures (*Cathartes aura*), key scavengers in many ecological communities¹, often feed on carcasses left behind by hunters who use lead (Pb) shot, resulting in their exposure to this toxic metal and a potential population genetic response. Currently, no information exists about genetic variation in susceptibility to Pb in vultures or whether past exposure to Pb has exerted selection for increased resistance to Pb in this species or any other raptor. Signatures of selection may be identified in the genome through detection of the "hitchhiking effect", in which selectively favorable mutations are fixed in a population thus altering the frequency of alleles at closely linked loci. Consistent with this, in the genome of the Turkey Vulture, we expect signatures of selection at loci associated with known toxic effects of Pb or its detoxification. Such loci may

include genes involved in oxidative stress response, heavy metal detoxification, and metal transport. We plan to conduct Illumina short-read sequencing of 10 Turkey Vultures that we previously caught, followed by genome assembly using a previous high-quality Turkey Vulture reference genome. We will identify signatures of selection in regions of the Turkey Vulture genome using outlier loci tests and neutrality test statistics such as Fay and Wu's and McDonald-Kreitman test. Evidence of genetic signatures of selection for resistance to Pb exposure in the Turkey Vulture genome will unveil how raptors might face toxicological risk from Pb pollution, and what the role is for evolution (as opposed to plasticity), in supporting the persistence of Turkey Vulture populations in the face of widespread Pb contamination.

25. DETERMINATION OF C92 AS AN ESSENTIAL PROTEIN FOR THE LYTIC CYCLE OF STIV3

George Mariscal*, Michael Overton, Jamie C. Snyder, Advisor: Jamie C. Snyder

The study of *Sulfolobus* turreted icosahedral virus (STIV) has led to the development of a genetic system to study archaeal viruses. Until the discovery of STIV there was not much known about archaeal viruses and their interaction with their hosts from the thermophilic Crenarcheota phylum. STIV is a model virus that replicates in acidic (pH 2.2) high temperature (82C) environments such as the hot springs in Yellowstone National Park, where it was originally discovered with its host *S. solfataricus*. STIV replicates via a lytic cycle where it forms 7 pyramidal-like shapes on the S-layer surface of its host prior to egressing. The C92 protein in the viral genome has been determined to play a key role in replication and formation of the pyramidal structures. It is evident C92 is essential to replication in STIV, but it is hypothesized to have a greater function than is currently understood. Recently, STIV3, a genetically similar variant of STIV has become a virus of interest that replicates in *S. acidocaldarius* via lysogenic cycle. A genetic system has recently been developed for STIV3 that is alternative to the current genetic system for STIV and is currently under review within our research. This project aims to determine whether C92 in STIV3 and STIV are functionally identical. To determine this, we will use site-directed mutagenesis followed by transfection to determine if the viral C92 mutants are capable of replication. Viral replication will be tested using qPCR, western blots, and plaque assay.

26. EXAMINING NON-PREGNANT MOUSE LOCOMOTOR ACTIVITY USING NANO TAGS®

Jessica Ivonne Martinez, Advisor: Juanita K. Jellyman

Nano tag is a novel three-axes accelerometer and temperature sensor for wireless measurement and storage of body temperature and activity data in mice. Few peer-reviewed studies have been published using nano tag devices and there are no published studies in pregnant mice. The objective of the current study was to assess the feasibility of using nano tags to measure animal activity levels before, and during, pregnancy in mice. Swiss Webster mice were used in the study. Under anesthesia, the nano tag was implanted subcutaneously. After at least 5 days of recovery, the mouse was mated overnight, and pregnancy confirmed by the presence of a copulatory plug. Body temperature and activity data were recorded continuously, stored in the nano tag device, and retrieved by near field communication. We will present preliminary temperature and activity data from four mice before and during pregnancy. Our long-term goal is to use nano tags to compare maternal activity levels in two groups of mice during pregnancy.

27. **SEED PREFERENCE OF SMALL MAMMALS AND BIRDS AND ITS IMPACTS ON COASTAL SAGE SCRUB RESTORATION EFFORTS**

Ashley L. Bartling, Sandra C. Dansereau, Maddison R. Mejia, Anthony W. Rondon, Erin J. Questad,
Advisor: Erin J. Questad

The California sage scrub ecosystem has become a habitat for both native and nonnative plant species. In response, restoration efforts are needed to help increase native populations. One of the easiest techniques for restoration is to seed the desired area. However, this method can be impacted by the presence of granivorous animal species, who consume the seeds before they have a chance to germinate. The seed preference of small mammals and birds can contribute to the establishment of invasive and native species throughout this ecosystem. In this study, seed preference trials were conducted from Summer of 2021 through Spring of 2022 to determine the dominant granivore species and the highest preferred seed species from a mix of eight species of native and nonnative seeds. The seeds were presented to consumers in glass petri dishes and monitored with motion-activated trail cameras. Determining which seed species they consume the most can help direct future restoration efforts in the sage scrub ecosystem.

28. **DEC-205-expressing dendritic cells inhibit T cell responses during West Nile Virus encephalitis in the central nervous system**

Chiefe Mo*, Cuong V. Thai, Advisor: Douglas M. Durrant

West Nile Virus (WNV), a neurotropic flavivirus, is the leading cause of mosquito-borne neuroinvasive disease in the U.S. Recent studies show that dysfunctional T cell responses correlate with severe disease in both humans and mice. Dendritic cells (DCs) are critical for reactivating antiviral CD8⁺ T cell responses in the CNS that are required to mitigate viral encephalitis. Previous reports have shown that CNS-localized DEC-205⁺ DCs accumulate within the CNS during WNV encephalitis; however, their specific role in programming T cell immunity remains poorly understood. DEC-205, an endocytic receptor expressed by DC subsets can promote either antigen-specific effector T cell activation or immunological T cell tolerance. Using a mouse model of WNV encephalitis, we demonstrate that DEC-205^{-/-} mice exhibit enhanced clinical signs of disease and increased mortality compared to WT controls. The enhanced susceptibility in DEC-205^{-/-} mice arose from an increased viral burden with the CNS; however, this was associated with increased inflammatory myeloid, CD4⁺, and CD8⁺ T cell infiltrates. In addition, expression of activation markers CD25 and CD44 increased while CD69 levels decreased within the DEC-205^{-/-} mice compared with their WT counterparts. CD69 expression has been shown to be associated with regulatory T cells. To confirm the immunomodulatory role of DEC-205, we will measure CD4⁺ regulatory T cell frequencies within the CNS of DEC-205^{-/-} and WT animals following WNV infection. Taken together, these data suggest that DEC-205 critically regulates WNV pathogenesis and neuroinvasive disease by limiting immune-mediated pathology in the CNS following WNV infection.

29. **Recombinant endolysin as an alternative to antibiotics to treat colibacillosis**

Richard Nunez Gomez, Meera C. Kelly, Advisor: Junjun Liu

Recombinant endolysin as an alternative to antibiotics to treat colibacillosis

Richard N. Gomez, Meera C. Kelly, Junjun Liu, Ph.D.
Department of Biological Sciences

California poultry industry is one of the state's agricultural leaders and has an enormous impact to the state's economy with sales value in excess of \$2.5 billion annually. One of the diseases threatening the poultry industry is colibacillosis, which is caused by avian pathogenic *E. coli* (APEC). In the past, antibiotics were used to control the disease. However, frequent use of antibiotics has resulted in resistance and causes food safety concerns. Now, California law bans the routine use of antibiotics, which makes it important to develop alternative approaches to prevent and treat colibacillosis. Endolysin is an enzyme coded by bacteriophage genome, which is capable of lysing bacteria and therefore becomes an attractive candidate. This study aims at the development of recombinant endolysin for the control of APEC. The recombinant endolysin will be engineered to pierce the outer membrane of the Gram-negative APEC and cause bacterial lysis.

30. Investigate whether Garlic modulates the TLR4 pathway differently in murine macrophage cell lines, J774A.1 and RAW264.7

Christian J. Ordaz, Advisor: Nancy Buckley

Garlic (*Allium sativum*) is known to have immunomodulatory effects. Macrophages are important innate immune cells that help remove pathogens. Macrophages can produce cytokines like tumor necrosis factor-alpha (TNF- α) in response to pathogens. Macrophages, via their toll-like receptor-4 (TLR4), detect lipopolysaccharide (LPS), a component of the outer membrane of gram-negative bacteria. LPS stimulates pro-inflammatory mediators such as TNF- α and nitric oxide (NO). TLR4 signaling activates the NF- κ B transcription factor to cause a pro-inflammatory response. We have found that garlic stimulates LPS-induced TNF- α secretion from J774A.1 but reduces LPS-induced TNF- α secretion from RAW 264.7 murine macrophages. Thus, we want to investigate whether garlic modulates the production of TNF- α and NO by altering the TLR4 signaling pathway differently in J774A.1 cells compared to RAW 264.7 cells. J774A.1 and RAW 264.7 macrophages were treated with LPS in the presence or absence of garlic. TNF- α cell secretion was assessed from cell supernatants collected 24h after treatment via enzyme-linked immunosorbent assay (ELISA). NO was assessed via the Griess assay. Thus far, we have confirmed that when J774A.1 cells are stimulated with LPS + Garlic, it significantly increases TNF- α secretion levels compared to LPS alone. RAW264.7 cells treated with LPS and Garlic have similar levels of secreted TNF- α levels to cells treated with LPS alone. We also found that Garlic reduced LPS-induced NO production in J774A.1 and RAW264.7 cells compared to LPS only treated cells. Preliminary studies in RAW 264.7 cells also revealed that Garlic alters cytokine and TLR4 mRNA expression transcription levels, suggesting a possible mechanism of action by Garlic. These findings are significant because they further elucidate how garlic affects macrophage immune responses to bacterial components such as LPS.

31. **Altering the ABE Fermentation Pathway in *Clostridium beijerinckii***

Mark Ortizt, Advisor: Wei-Jen Lin

Clostridium beijerinckii has an interesting and extremely useful process that could be harnessed by humanity to better treat ailments or even create a powerful and viable biofuel, however rate of production of these biochemicals is below desired parameters. This process is called ABE fermentation or acetone-butanol-ethanol fermentation and through various other biological processes can also transform into IBE with isopropanol replacing acetone. By utilizing certain gene enhancers and suppressers depending on what genes activated what genes and culturing specific *Clostridium* strains to see if there are any increases in biochemical production and hopefully exclusive productions of biochemicals, specifically either butanol, or butyric acid or possibly even isopropanol. Utilizing genetic analysis databases such as NCBI Genome and tracking and comparing FASTA files of genes of interest that are known to have a specific part in the metabolic process of the ABE pathway. In this study, we identified x genes from the ABE pathway and x gene. We identified C. b strains isolated from CPP farms were also analyzed for their butyric acid and butanol production. strains of various yields of butyric acid and butanol will be compared to further understand the regulation of ABE/IBE fermentation pathway

32. **Effects of $\Delta 9$ -Tetrahydrocannabinol on Chicken Embryo Growth**

Kenneth Paredes*, Maya Shattuck, Diana Truong, Juanita Jellyman, Advisor: Juanita Jellyman

Over the past 10 years, medical marijuana (*Cannabis sativa*) has been approved for use in > 22 states. Over a similar time, marijuana use has increased, including by pregnant women. Marijuana use is associated with low birthweight in humans. Similarly, exposure to $\Delta 9$ -THC reduced birthweights in mice. Cannabis may affect birth weight by changing maternal physiology, placental function, or the growth of the offspring. The objective of the current study was to develop a chick embryo model of embryonic growth. Ten chicken eggs were injected with 50 μ l warm saline on alternating days from day 2 of development. After euthanasia, images were taken to assess vascularization of the chorioallantoic membrane (n=2; day 10) and the egg weight, chick weight, head circumference, and limb lengths were measured (n=8; day 20). Data are mean \pm sem. On day 20, we established mean values for egg weight (48.4 ± 0.500 g), chick weight (20.4 ± 0.975 g), head circumference (39.2 ± 0.268 mm) and wing length (28.6 ± 0.696 mm). The long-term goal of this study is to use our model to determine the direct effects of $\Delta 9$ -THC exposure on growth and development in chicken embryos.

33. **Determining the Molecular Mechanisms Behind PMN Trogocytosis of *Trichomonas vaginalis***

Ashley Denise Ramirez*, Frances Mercer, Advisor: Frances Mercer

Trichomonas vaginalis (Tv) is a flagellated unicellular parasite responsible for causing the most common non-viral sexually-transmitted infection worldwide, trichomoniasis. Trichomoniasis affects 245 million people annually, with 6.9 million of those cases being in the U.S. alone and has been linked to a direct medical cost in the U.S. of 1.44 million per year. Although Tv is highly prevalent, because it is so understudied, it has been classified as a neglected parasite. A deeper understanding of the molecular mechanisms involved in the killing of the parasite could aid in the

effective vaccine design against Tv. It is known that a type of white blood cell called neutrophils (PMN) are critical in the killing and clearance of Tv via a contact-dependent mechanism called trophocytosis in which PMN surround the parasite and take bites preceding parasite death. However, the molecular players involved in this contact-dependent process remain unknown. Since a previous study has shown that PMN cell surface receptor, FcγRIIIa, is required for trophocytosis of breast cancer cells, we hypothesize that FcγRIIIa may be required for the trophocytosis of Tv as well. To test this, we are designing FcγRIIIa knock-out (KO) clones using mammalian promyelocytic cell line PLB-985. We differentiate these clones to become neutrophil-like cells (NLCs) and conduct cytolysis assays in which percent parasite killing is determined. Preliminary results show that percent parasite killing is significantly decreased in FcγRIIIa KO clones compared to control NLCs. To further investigate where the fragments of trophocytosed Tv are localizing in PMN, we are conducting trophocytosis assays in which we co-incubate fluorescently labelled Tv and NLCs and observe them under the confocal microscope. Preliminary results suggest that some fragments of trophocytosed Tv are being localized to PMN lysosomes.

34. Investigating the growth of different *Tritrichomonas foetus* strains at different pHs

Bryan Ramirez Reyes, Frances Mercer, Advisor: Frances Mercer

Tritrichomonas foetus is a unicellular flagellated protozoan parasite known to cause trichomoniasis in cattle. Trichomoniasis is a sexually transmitted disease known to affect the reproductive tract of cattle, resulting in abortion and reduced fertility. However, how the immune system combats trichomoniasis is under-characterized. In order to examine *T. foetus* and the immune response against it, we must first be able to cultivate it. *T. foetus* is most commonly grown in Diamonds media, however the optimal pH that each different strain grows in is unknown. In a literature search, we found that researchers typically grew *T. foetus* in a pH of 7.2. *Trichomonas vaginalis*, a similar parasite known to cause trichomoniasis in humans, is grown at a pH of 6.2. Meanwhile, no modification to the Diamonds media will result in a pH of 6.8. Therefore, we hypothesize that modification of Diamonds growth media to a pH of 7.2 will result in a greater cell count and viability, in comparison to pH 6.2 and 6.8. We will grow four different strains of *T. foetus* in Diamonds media at pHs of 6.2, 6.8 and 7.2, and compare the growth of these parasites over 7 consecutive days. The concentration of *T. foetus* will be determined via microscope using the hemocytometer and by flow cytometry. Data for strains KV-1 and BP-4 indicate a preference for more basic media, pH 6.8 and 7.2. Overall, these results will help determine the optimal pH modification to grow viable *T. foetus* cultures, which will help expand future *T. foetus* research.

35. Imidacloprid, not kaolin clay, affects floral visitation to watermelon flowers

Emily J. Roman, Seth Kapp, Vonny M. Barlow, Joan M. Leong, Advisor: Joan M. Leong

Production of melons in the desert valleys of southeastern CA requires management to control for silverleaf whitefly populations. Control of populations is typically done with a soil application of a neonicotinoid insecticide like imidacloprid. Neonicotinoids have been shown to cause a variety of sublethal effects in bees, which are the primary pollinators of watermelon crops. We examined whether the use of an alternative treatment, kaolin clay, as well as imidacloprid, influenced overall insect floral visitation, honey bee floral visitation and bee

foraging behavior in watermelon grown in the Imperial Valley. The experimental treatments were: 1) a neonicotinoid insecticide (imidacloprid) applied at planting, 2) a kaolin clay particle film applied every 14 d, 3) untreated controls. Floral visitor activity on field flowers was quantified by video surveillance of floral arrays composed of five watermelon flowers. All floral visitors, as well as just honey bees, *Apis mellifera*, were less numerous on the imidacloprid treated flowers. Honey bees that did visit flowers showed longer floral visit durations on the neonicotinoid treated flowers compared to the other treatments. Honey bee visit durations averaged 9.8 s in the neonicotinoid treatment, compared to 5.7 s in the kaolin treatment, and 4.8 s in the control treatment. Surprisingly, the visit durations of revisitor honey bees (those that revisit the same flower repeatedly) showed a different pattern. Our field data suggest that imidacloprid, the most widely used insecticide in agriculture, reduces floral visitation in watermelon, but at the same time, increases the visit duration time of honey bees when they do visit watermelon flowers. Application of kaolin clay does not appear to adversely affect insect visitation to watermelon flowers.

36. Determining which KSHV K8.1 protein inhibits human CD1c from communicating with the immune system.

Isabel Romero, Advisor: David J Sanchez

Kaposi's sarcoma herpesvirus (KSHV) is a virus known to cause Kaposi sarcoma which leads to a rare cancer that causes lesions to grow on the body and can cause different types of lymphoma cancers that target the immune system. Once KSHV infects a cell, it wreaks havoc by triggering a domino effect of signals in which the cellular microenvironment is made optimal for viral infection. KSHV is well known to block different pathways of the immune system so that its virus replication cannot be stopped by the immune system. Our lab has found that KSHV blocks the CD1 system, which is used by the immune system to signal that there is a problem in the cell. We saw that KSHV leads to downregulation of the CD1c protein from the surface of infected cells. Our goal is to understand how KSHV blocks the CD1c proteins from being on the cell surface. We are focusing on the K8.1, viral protein, which we saw leads to CD1c being downregulated from the cell surface. Our goal is to determine how K8.1 functions to block CD1c. I will utilize a set of K8.1 mutations to determine which part of K8.1 is necessary to destroy the cellular CD1c proteins. We have used transfections and western blots to determine the stability of the mutant proteins. We saw that all mutants of K8.1 were stable by western blot analysis. We can use them to determine how K8.1 functions. In order to determine which K8.1 mutant blocks CD1c, we will use b and t cells rather than HEK 293t.

37. Differential Expression of Antioxidant Genes in Louisiana Seaside Sparrows (*Ammodramus maritima*) Following the Deepwater Horizon Oil Spill.

Grigor Tombulyan, Cecilia Saenz, Aaron Angel, Andrea Bonisoli-Alquati, Advisor: Andrea Bonisoli-Alquati

The Deepwater Horizon (DWH) oil spill released 780,000 m³ of oil into the Gulf of Mexico, exposing marine ecosystems to polycyclic aromatic hydrocarbons (PAHs), the main toxicants in oil. Previous studies have shown an increased expression of the *cyp1a* gene, a common biomarker of

exposure to PAHs, in a variety of aquatic and terrestrial animals from oil contaminated sites. These organisms include the Seaside Sparrow (*Ammodramus maritimus*), a resident bird of the Gulf Coast. Seaside Sparrows from more contaminated sites (as measured by higher sediment PAHs concentrations) also had lower levels of oxidized glutathione (GSSG). Glutathione is an intracellular antioxidant considered the first line of defense against oxidative stress. It is found in equilibrium between GSSG and reduced glutathione (GSH). A decrease in the ratio of GSSG to GSH among oil-exposed birds implies low oxidative damage, and indicates a possible upregulation of antioxidant defenses to prevent oxidative damage induced by PAHs. To investigate the transcriptional bases of this potential upregulation, this study will measure the expression of genes coding for glutathione reductase (GP), responsible for reducing GSSG to GSH, and glutathione peroxidase (GPx), which oxidizes GSH back into GSSG, in the hearts of Seaside Sparrows. We hypothesize an increase in expression of the GP gene, and a decrease in expression of the GPx gene in birds exposed to oil from the spill. We have extracted RNA from heart tissues, and reverse-transcribed it into cDNA. Our next step is to conduct RT-qPCR to quantify the expression of those antioxidant genes.

38. **Role of Glutathione (GSH) in mediating Garlic's immune regulatory effects in Heat Killed *Candida albicans* challenged J774A.1 macrophage cells**

Gayatri Deepti Sambhara, Advisor: Nancy E. Buckley

We investigated garlic's effects on the immune responses generated by Heat killed *Candida albicans* stimulated J774A.1 macrophage cells. We use Heat-Killed *C. albicans* (HK *C. albicans*) because it is known to induce consistent immune responses from macrophages. We plated J774A.1 cells at 1.25×10^5 cells/mL and treated with garlic both in the presence and absence of HK *C. albicans*. Cell supernatants were collected 24h after treatment to assess TNF- α and IL-6 levels and Nitric Oxide production from HK *C. albicans* challenged cells using enzyme linked immunosorbent assays (ELISA) and Griess assay respectively. We also analyzed the cytokine mRNA levels for TNF- α using RT-qPCR, but this remains to be confirmed. We found that garlic reduced HK *C. albicans*- induced pro-inflammatory cytokines (IL-1 β , IL-6, TNF- α) production but had no effect on Nitric Oxide (NO) production in J774A.1 murine macrophage cells. We will next investigate whether Glutathione (GSH) - an antioxidant and a tripeptide present in all eukaryotic cells, mediates garlic's immune regulatory effects on HK *C. albicans* induced pro-inflammatory cytokines levels in J774A.1 macrophage cells. GSH prevents damage to cells by reducing the accumulation of reactive oxygen species inside the cells. We believe that our findings will be helpful in the area of phytomedicine because they will provide insight into garlic's role as an anti-inflammatory agent and the mechanism through which it reduces inflammation inside the cells.

39. **Exploring IgA antibody and neutrophil Fc alpha receptor interactions during trophocytic killing of *Trichomonas vaginalis***

Bethany N Sesti, Suhani Bhakta, Francie K Mercer, Advisor: Francie K Mercer

The extracellular parasite, *Trichomonas vaginalis*, is a unicellular protozoan responsible for causing the most common, non-viral, human sexually transmitted disease called Trichomoniasis. Symptoms include itching or burning during/after urination and vaginal/penile discharge.

Complications may be infertility, preterm delivery, and increased risk of contracting HIV. Neutrophils are the predominant type of leukocyte to respond to the site of infection and actively kill *T. vaginalis* through trogocytosis, which is a contact-dependent and dose-dependent means of killing. We know that IgA antibodies are present in mucosal areas, such as the vagina. However, the role of antibodies in immunity to the parasite is under-characterized. One remaining unknown is whether there is a receptor-ligand interaction between neutrophils and *T. vaginalis*, and if it contributes to or affects efficiency of trogocytosis. We hypothesize that the interaction between IgA antibodies and the Fc alpha receptor (Fc α R), also called CD89, located on the surface of neutrophils, induces trogocytosis killing. To test this hypothesis, we will knock out the CD89 gene in a neutrophil-like-cell line (NLC). The NLC precursor cells will be transfected with an HDR oligo via the CRISPR/Cas9 mechanism. We will then screen the resultant mutant clones to confirm loss of function of CD89. Finally, a co-culture between CD89 knockout NLCs and *T. vaginalis* will be performed to determine whether the loss of CD89 affects efficiency of trogocytosis killing. The conclusion of this research could inform the development of preventative pharmaceuticals and new treatment methods for individuals at risk, infected with, or afflicted by trichomoniasis.

40. **Manipulating Dopamine Production Using Conditional Genetics to Define a Neural Circuit Required for Diet-Induced Obesity in Mice**

Sarah I. Sharif, Firozeh Farahmand, Advisor: Andrew D. Steele

Obesity is a major public health problem, predisposing people to type 2 diabetes and heart disease, among other problems. High fat food consumption can disrupt circadian rhythms as well as the reward system within the brain which can contribute to diet-induced obesity (DIO). DIO has been found to be reliant on dopamine signaling in humans as well as mice, which are ordinarily nocturnal. Mice lacking the dopamine receptor 1 (D1R) are resistant to DIO and this is associated with lower consumption of food during the day. However, when D1R is restored in the suprachiasmatic nucleus (SCN) (the primary mediator of circadian rhythms) in mice that were originally D1R knockouts, the day-eating increases along with DIO. It has been determined that dopamine neurons from the ventral tegmental area (VTA) do project to the SCN; the question is which VTA dopamine neurons are responsible for DIO caused by day-eating. This is being studied by creating conditional deletions for the tyrosine hydroxylase (TH) gene in mice using *Ntsr1-Cre*. This conditional deletion was verified with immunostaining, which revealed a large deletion of TH from many neurons in the VTA. After measuring body weight for 3 weeks on normal chow, and 6 weeks on a high fat diet, it was determined that the *Ntsr1-Cre* conditional knock-outs (cKO) did not exhibit DIO, which would suggest that *Ntsr1* dopamine neurons are necessary for DIO. Currently, we are using stereotaxic delivery of adeno-associated virus (AAV) which encodes TH to the VTA *Ntsr1* neurons in the cKO. In dual recombinase mice which express FlpO-dependent Cre recombinase in *Ntsr1* neurons, AAV injections into the VTA are used to delete TH from *Ntsr1* neurons in adulthood. In both cases, we are working to establish that these viruses can be used to restore and delete TH from *Ntsr1* neurons, and diet-induced obesity.

41. **Effects of $\Delta 9$ -Tetrahydrocannabinol on Cardiovascular Function in Chick Embryos**

Maya Shattuck, Kenneth Paredes, Diana Truong, Advisor: Juanita Jellyman

The recent legalization of Marijuana for recreational and medicinal use has led to an increase in usage, including by pregnant women. The long-term goal of this study is to use a chick embryo model to determine the effects of $\Delta 9$ -THC on an embryo, independent of maternal and placental physiology. To establish a method for measuring cardiovascular function in chick embryos, ten fertilized chicken eggs were injected with saline (50 ml), which is the vehicle that will be used to administer $\Delta 9$ -THC. Eggs were injected on alternating days from day 2 until day 20. Starting day 12, basal heart rate was measured every two days using the Buddy Mk2 Digital Egg monitor. Heart rate was measured at 37°C every 30 seconds for 10 minutes and the mean value was recorded. The heart rate response to decreased ambient temperature was measured on day 16 by placing the Buddy monitor at room temperature (23°C) and recording heart rate every 30 seconds for 10 minutes. Mean basal heart rate was 243 ± 7 beats/minute and the mean change in heart rate after 10 min at 23°C was a decrease of 18 ± 6 beats/minute. We have established a technique to measure resting heart rate and the change in heart rate in response to decreased ambient temperature in chicken embryos. The long-term goal of the project is to use the chick embryo model to determine the effects of exposure to environmental and other chemicals on cardiovascular function in ovo.

42. **Genetic Identification of a Population of Dopamine Neurons That is Necessary for Circadian Food Anticipatory Activity**

Jacqueline R. Trzeciak, Nora T. Elsharhawy, Wyatt J. Kaiban, Advisor: Andrew Steele

Dopamine (DA) signaling plays a vital role in circadian entrainment to food availability, particularly the development of food anticipatory activity (FAA). FAA is characterized by high levels of locomotor activity preceding a scheduled meal time and is regulated independently of the suprachiasmatic nucleus (SCN). While prior experiments have failed to pinpoint a single locus of control for FAA and circadian food entrainment, some studies have implicated that DA signaling in the dorsal striatum acts on Dopamine 1 receptors (D1R) to link mealtime to circadian activity cycles. Due to its role in reward pathways, understanding DA signaling and its part in circadian food entrainment can have implications in diet-induced obesity, eating disorders, and addiction pathologies. To identify the subpopulation of DA neurons required for FAA, we conditionally deleted tyrosine hydroxylase (TH), the rate limiting enzyme for dopamine synthesis, with Cre recombinase targeted to the DAT (Dopamine transporter) locus. With this deletion we observed a large loss of TH expression in midbrain neurons coupled with a lack of FAA. Restoration of TH to DAT-Cre DA neurons in the substantia nigra (SN) using adeno-associated virus (AAV) re-established FAA in the DAT-Cre; FloxTH mice. To further refine an FAA-mediating neuron population we screened several candidate DAT-positive populations, deleting TH using Vglut2-Cre, Ntsr1-Cre, Sox6-Cre and FoxP2-Cre mouse lines. These deletions of TH, many of which were very large, either did not impair or only slightly impaired FAA. We then deleted TH using Calbindin1-Cre and observed a dramatic impairment in FAA despite the TH deletion being one of the smallest we created. These results suggest that a population of the DAT-Cre, Calbindin1-Cre -expressing DA neurons play a key role in mediating FAA.

43. **Role of neutrophil Fc γ RI and Fc γ RIII against *Trichomonas vaginalis***

George Tseng, Suhani Bhakta, Cassandra Lopez, Advisor: Frances K Mercer

Trichomonas vaginalis is the causative agent for the most common nonviral sexually transmitted infection called trichomoniasis. Although most infections are asymptomatic, acutely symptomatic incidence is higher in women. Persistent trichomoniasis is associated with various complications such as increased HIV susceptibility, low infant birth weight, and increased risk for developing cervical cancer. In vitro studies identified neutrophils as the primary immune cells recruited to the site of infection and combat *T. vaginalis*. Neutrophils surround the *T. vaginalis* parasite and utilize a novel process called trogocytosis to take small pieces off *T. vaginalis*' cell membrane until the parasite dies. However, the molecular mechanisms that facilitate neutrophil contact, trogocytosis, and cytotoxicity of *T. vaginalis* parasites remain unknown. In this presentation, we report our research progress involving two neutrophil surface receptors, FcγRI and FcγRIII, and serum antibodies that may potentially be involved in bridging the contact between neutrophils and *T. vaginalis*. Using an in vitro cell line model of neutrophils derived from either HL-60 or PLB-985 cells, we identified only FcγRI, not FcγRIII, to be present on the cell surface of terminally differentiated neutrophil-like cells (NLCs). We determined human IgG1, IgG2, and IgG3 as serum components that can bind to *T. vaginalis* surface. We are currently conducting experiments to examine the role of FcγRI in cytotoxic and trogocytic killing by testing NLCs deficient in FcγRI against *T. vaginalis*.

44. **Identification of Dendrodoris and Doriopsilla Species Using Molecular and Morphological Data**

Tatiana A Vargas Hernandez, Advisor: Angel Valdes

Morphological characteristics have been the basis for recognizing and identifying sea slug species. In sea slugs, vivid body colors and unique patterns have served as a tool to identify and differentiate species; however, when color pattern variations exist, disagreements arise about the classification of certain species, making external morphology unreliable. In such cases, molecular data can revise nudibranch identifications. In this study, we are examining species of *Dendrodoris* and *Doriopsilla* collected in Koumac, New Caledonia. Our goals for this study are to clarify the identity of 7 *Dendrodoris* species and 2 *Doriopsilla* species collected from Koumac, New Caledonia using molecular data obtained by sequencing mitochondrial genes CO1 and 16S and, the nuclear gene H3. In addition to molecular analyses, reproductive system analyses will be conducted to provide supportive morphological data to further discuss the taxonomical identity of each species.

45. **Diabetes Prevention Through Lifestyle Changes in African Americans**

Zoe A Walker, Advisor: Juanita Jellyman

Type 2 Diabetes is a metabolic disorder in which the body does not produce enough insulin, or cells do not respond to insulin, resulting in chronic hyperglycemia. Individuals with prediabetes are at risk of developing type 2 diabetes. Diabetes increases an individual's risk of health conditions including heart attack, stroke, kidney disease, and vision loss. In the United States, approximately 26.9 million adults have type 2 diabetes, and 88 million adults are prediabetic. Additionally, ~\$327 billion is spent on diabetes-related medical costs annually in the United States. The National Diabetes Prevention Program (DPP) was a large, multicenter clinical research study that showed that lifestyle intervention reduced the incidence of diabetes. The study showed that

a 5-7% decrease in body weight, through calorie reduction and incorporation of at least 150 minutes of physical activity each week, delayed the onset of type 2 diabetes by 58% in high-risk adults. Moreover, lifestyle intervention was more effective at delaying the onset of type 2 diabetes than the anti-diabetic drug metformin. The objective of the current study is to determine the effectiveness of the DPP in African Americans who are going through one of the CDC-recognized programs together in their community. Body weight and activity minutes will be measured weekly. The percentage of glycated hemoglobin (HbA1C), an indicator of blood glucose regulation, will be measured at the start, at 6 months, and at 12 months. We hypothesize that the DPP will reduce diabetes risk in African Americans.

46. Camera Trap Analysis and Occupancy Modeling of Wildlife Activity and Diversity in Restored Riparian Habitats and Avocado and Citrus Orchards

Betty Wong, Advisor: Elizabeth Scordato

Conservation efforts often focus on restoring and protecting natural areas with the goal of facilitating biodiversity growth and ecosystem services. However, some recent studies have discovered that agricultural lands may serve as important habitats for wildlife, particularly mammals. These lands include avocado and citrus orchards, which have been identified as potential corridors for wildlife as they can provide food, cover, and enhance biodiversity within agroecosystems. Monitoring wildlife activity in agricultural areas near natural habitats is not common, but it is critical for understanding the diversity, richness, and habitat use of wildlife species as agricultural systems continue to expand. In this study, we are assessing mammal activity and habitat use in citrus and avocado orchards and in adjacent restored riparian habitats. We are monitoring activity using motion-activated cameras. We are using occupancy modeling to compare temporal and spatial variation in wildlife community diversity and structure between the orchards and riparian habitat. Thus far, we have found higher mammal diversity in orchards compared to the natural riparian area, which is surprising considering orchards are more human-disturbed than the natural areas. Knowledge of the most frequented habitats by wildlife can influence conservation decisions. Since avocado and citrus orchards appear to be a hotspot for mammal biodiversity, we advocate exploring ways to make these agricultural lands more appealing to the wildlife.

47. A morphological phylogeny of the genus, *Hemichaena*

Aiko Yamada, Advisor: Paul Beardsley

The genus *Hemichaena* encompasses 5 unique species. Via herbaria specimen data collected online, the morphological traits of each species were recorded. Though still in progress, the information collected will be used to create a phylogeny of the genus. *Hemichaena* has historically been associated with the genus *Mimulus*, which is widely investigated in the field of systematics. Recent phylogenetic studies have utilized molecular data to determine classification analysis. Through a morphological study of the *Hemichaena* species, basic field recognition techniques can be refined. Focusing on the physical traits of plant specimens is useful to apply in floristic studies and beyond. The project also employs herbaria specimens which are an important asset to plant

systematists.

48. **Formulation and Effect of Edible Coatings Based on Nanoparticles and Nanoemulsions and on the Shelf-Life of Avocados**

Christianne Yapor*, Rosalie Rodriguez, Julia Duddles, Elvira Atmadja, Advisor: Gabriel Davidov-Pardo

Over the past two decades, there has been a steady increase in the consumption of avocados, however, over 5,000 tons are wasted at the retail level per year. Avocados experience rapid ethylene production post-harvest which leads to fast ripening. Two hydrophobic edible coatings based on nanoemulsions and protein nanoparticles were formulated to assess their effect on the shelf-life of avocados. Zein nanoparticles were formulated using anti-solvent precipitation with 3% zein dissolved in an 85% ethanol solution as the solvent, which was added to the anti-solvent of 5mM buffer at pH 8 in a 2.5:1 anti-solvent to solvent ratio. The particles showed an average diameter $280.47 \pm 10.96 \text{ nm}$ and $-33.50 \pm 2.05 \text{ mV}$ of zeta-potential. Oil-in-water nanoemulsions were made using high-pressure homogenization using 10% MCT oil, 1% polysorbate 80, and 89% distilled water. The average diameter of the nanoemulsion made with 3 passes for the coating was $181.53 \pm 5.06 \text{ nm}$, and the zeta-potential $-12.30 \pm 73 \text{ mV}$. Hass avocados were dipped into one of these two treatments or a control, and physical characteristics including the color of skin and flesh, moisture loss, and firmness of flesh was analyzed every 3-4 days to compare the effects of each treatment. Over 14 days, the fruits lost 13%-15% moisture. A darkening of the skin was shown due to increased anthocyanin production. Polygalacturonase and pectin methylesterase contributed to the breakdown of pectin, which caused loss of structural integrity during ripening. While the coatings tested in this study did not show a significant effect, the method is still promising.

49. **Roots of Hope: Diabetes Prevention During a Pandemic**

Nereyda Zecena, Nairi Azajian, Frande Herrera, Advisor: Juanita Jellyman

In the United States, >23 million adults have diabetes, and 84 million are prediabetic. The Diabetes Prevention Program (DPP), a randomized clinical trial, showed that lifestyle intervention reduced the incidence of diabetes. [1] That study showed a 7% decrease in body weight and 150 minutes of physical activity each week delayed the onset of type 2 diabetes by 58% compared to 31% in individuals that took metformin.[1] Whether it is feasible to use the DPP to prevent type 2 diabetes outside of controlled clinical setting during a pandemic is unknown. Previous studies determined the feasibility of offering the DPP in Los Angeles County communities. The current study aimed to determine the feasibility and success of the DPP during the pandemic. We hypothesized that participation in the DPP would reduce diabetes risk through weight loss, increased physical activity and decreased % of glycosylated hemoglobin (HbA1C). Twelve overweight individuals with prediabetes or at risk for developing diabetes participated in the 12-month Roots of Hope DPP program. Body weight and activity minutes were recorded weekly. HbA1C levels were measured every 6 months. Participants lost $2 \pm 4 \%$ body weight and exercised for 273 ± 25 minutes per week over the 12-month period. HbA1C levels decreased from $5.8 \pm 0.4\%$ at the start of the program to $5.7 \pm 0.5\%$ between 6 months. These data suggest that the DPP may

not be an effective method for reducing the risk of type 2 diabetes in community settings in Los Angeles County during a pandemic.

50. Does pesticide use influence phenology and fitness of California birds? A study using citizen science data

Yuzhong Zhang, Advisor: Andrea Bonisoli Alquati

The invention of pesticides gave the agricultural industry a chance to match up against the fast-growing demand for their food products. However, the widespread use of agricultural pesticides has proven a threat to organisms and ecosystems. Past studies suggest popular pesticides such as chlorpyrifos, imidacloprid, clothianidin, fipronil, and aldicarb, among others, have a negative impact on birds' fitness. Birds' relatively high positions in the trophic web of agroecosystems expose them to the threat. Research has shown that farmland birds are in a steeper decline than birds from other ecosystems. Although such decline most likely results from the synergism of several factors, many studies do suggest pesticides as one of the potential causes. This study aims to investigate whether the use of agricultural pesticides is associated with negative impacts on birds' fitness, by analyzing how pesticides use, in space and time, predicts the abundance, phenology, and fitness of birds. To this aim, I will be using citizen science data about bird abundance and phenology, and governmental data about pesticide use. I hypothesize that higher pesticide use will be associated with lower local abundance, abnormal breeding dates, and lower clutch size and fledging success. Aside from pesticides use, habitat loss, fragmentation, and climate change may also be reasons for the population decline. Future developments will focus on incorporating these covariates and use information-theoretic approaches to find the most informative models explaining bird phenology and fitness. Overall, this study will help reveal the true ecological costs associated with pesticide usage in California. The results will have implications for species conservation as well as for planning of risk assessment studies and decision-making related to pesticide policies.

51. Garlic May Increase Lipoteichoic Acid Stimulated Secretion of Tumor Necrosis Factor Alpha from J774A.1 and RAW264.7 Cells

Benjamin Zousel*, Advisor: Nancy Buckley

Garlic has long been known to affect the immune system, and macrophages are an important group of cells within the innate immune system. Our project looks at how garlic influences the secretion of tumor necrosis factor alpha (TNF- α) from lipoteichoic acid (LTA) stimulated mouse macrophages. TNF- α is a cytokine that normally leads to inflammation, with macrophages being the molecule's major producers. LTA is a molecule from gram-positive bacterial cell walls that can cause inflammation. In our laboratory, it has been found that garlic modulates TNF- α production from J774A.1 and RAW 264.7 macrophages stimulated with lipopolysaccharide (LPS), a component of the outer membrane of gram-negative bacteria. Thus, we investigated whether garlic could modulate LTA-induced TNF- α secretion. J774A.1 and RAW 264.7 cells were treated with various LTA concentrations (1-0.1 $\mu\text{g}/\text{mL}$), with or without garlic (3-5 $\mu\text{g}/\text{mL}$). The production of TNF- α was analyzed by enzyme linked immunosorbent assay (ELISA), and the cell protein content was

analyzed by BIO RAD protein assay. Our findings for both cell lines were a pattern of increased TNF- α secretion with the addition of garlic, but these differences were not statistically significant. For the protein assay with J774A.1 cells, garlic led to a statistically significant reduction of overall cell protein concentration for the control (no LTA) treatment. For the protein assay with RAW 264.7 cells, garlic led to a statistically significant reduction of cell protein concentration for all treatments (except LTA 0.1 $\mu\text{g}/\text{mL}$). These results indicate that garlic may increase TNF- α secretion from both cell lines, but this would require additional experiments for confirmation. This research is important to phytomedicine because it can help to clarify the effect that garlic has on cells of the immune system.

52. **Social Behavior of Waterfowl in an Urban Park**

Stephanie S. Zuniga, Advisor: Janel Ortiz

This work explores the effect humans have on wildlife when intertwined with the urban environment. It questions if wild ducks and geese in an urban park display dominant behavior characteristics when humans are present. My research objective is to investigate which waterfowl group is the most dominant in their behavior with the presence of humans. Behavioral observations were recorded in approximately 3 acres of Earvin Magic Johnson Park in Los Angeles, CA using mixed species instantaneous scan sampling at three minute intervals for one hour for 6 weeks. I expected that there would be no difference in behavior between ducks and geese when people are present. Data suggests ducks are more likely to approach and chase than geese. The data also shows geese tend to move in groups. However, I was unable to account for human presence due to unforeseen circumstances. The presence of dominant behaviors in wildlife in an urban setting can pose challenges to humans coexisting in those places due to increased opportunity for both positive and negative interactions. Further research would need to be conducted in order to explore if humans play a role in the behavioral dominance among ducks and geese.

53. **Dermal Toxicity and Irritation Study in SKH-1 Hairless Mice of R-carvedilol Transfersome Gel**

Jeremiah Reyes, Advisor: Ying Huang

Carvedilol is a β -blocker that is commonly used in patients for high blood pressure and heart failure. More recently, carvedilol and the non- β -blocking enantiomer R-carvedilol are being used and tested for its ability to help prevent different types of cancers. According to previous studies, R-carvedilol loaded transfersome, namely T-RCAR can permeate the skin of porcine ears and of mice.

54. **The effects of a high-fat diet during pregnancy on offspring growth and pancreatic function**

Gabrielle Rodriguez, Liliana Jimenez, Teresa Meza, Rushni Wickramasinghe, Tory Simpfenderfer, Advisor: Juanita Jellyman

In humans and animals, maternal consumption of a high fat diet during pregnancy is associated with obesity and insulin resistance in the offspring later in life¹. Whether maternal high fat diet alters the function of the pancreatic β -cells in the offspring is not known. Four Dorset ewes were

used in the study. After mating, control animals (C; n=2) were provided with 100% of the nutritional council recommendation (NCR) and high-fat diet sheep (HFD; n=2) were provided with 120% NCR. One offspring from each ewe was studied after birth. Lambs were weighed every day after birth and food intake was measured every day from weeks 10-16. Glucose-stimulated insulin secretion was measured by the glucose tolerance test. There was no difference in birth weight between C (3.6 ± 0.33) and HFD (4.1 ± 0.24 ; $P < 0.05$) offspring. Preliminary data from the tests of pancreatic β -cell function will be presented. The current study is the first to describe the effects of maternal consumption of a high fat diet on offspring β -cell function in sheep.

55. **Exploring Parallel Anytime Designs for Real Time Content Based Image Retrieval Algorithms**

Daeyoung Hwang, Sairaj S. Jadhav, Advisor: John Korah

With the drastic rise in available digital image data, there has been an increase in need for more robust and efficient image processing. Content Based Image Retrieval (CBIR) attempts to address the increased demand by providing a consistent, automated way to compare and retrieve images by comparing the images' visual contents. Feature detection, description, and matching are foundational parts of CBIR algorithms, and the features used can range from color, texture, intensity, spatial features, etc. While CBIR algorithms have been utilized with varying success, they are often specialized to a specific type of application or dataset. Additionally, because CBIR algorithms assess each pixel of the image, they are resource intensive, making it inapt for real time image data. In this research, we examine current CBIR algorithms, and we experiment with different ways to expedite the process to make them more applicable to real time image data processing. First, we examine CBIR algorithms to find components that are amenable to the Anytime design. For an algorithm to be Anytime, the program must yield improved result with additional resources and be interruptible at any time if a specific threshold is met or if the improvement in result no longer warrants additional resources. Anytime design provides better resource allocation, as we can prioritize resources on those that seem most promising. Furthermore, we seek to parallelize our Anytime design to further speed up the process while maintaining its robustness. For this initial research, we explore various CBIR algorithms with robust feature detection and matching algorithms. We then formulate and validate the initial findings of our parallel Anytime design on the CBIR algorithms, and we delve into other avenues for improving their efficiency to meet the need for real time image retrieval.

56. **Neuronal Analysis of Cognitive Processing Hippocampal Subregions in Demented vs Non-Demented Alzheimer's Disease Individuals**

Ayah Elsamad, Lee Tharachai, Vivianne Mitri, Advisor: Glenn Kageyama

Alzheimer's disease is a neurological disorder diagnosed in individuals with a high amount of neurofibrillary tangles and beta-amyloid plaques known to lead to neurodegeneration and atrophy throughout the brain causing them to suffer from dementia. A subgroup of Alzheimer's Disease (AD) individuals who are not widely recognized have been shown to display standard AD brain pathology yet do not suffer from dementia. This group of people also demonstrate cognitive function ability similar to the average middle-aged cognitively normal individual. Little is known on how non-demented AD patients are able to avoid dementia and can function at a cognitively

normal rate. We conducted a quantitative analysis on healthy neuron survival and size between demented and non-demented AD cases in subregions of the brain associated with higher cognitive thinking, including the CA1, Entorhinal Cortex, and Subiculum. We found a greater number of healthy Tau- neurons in the non-demented AD cases in the 3 cognitive processing areas. In many cases, Tau- healthy neurons also have a tendency to undergo hypertrophy. This suggests that neurons are able to somehow survive and thrive in this subgroup of people although having the same brain pathology as those with demented AD.

57. **Analysis of the CA1 region in non-demented and demented Alzheimer's patients**

Karen Rendon, Diana Aguilar, Thanya Gurrola- Fonse, Ayah Elsamad, Vivianne Mitri, Advisor: Glenn Kageyama

The focus of this research is to compare neurological differences of brain tissue between patients diagnosed with Alzheimer's disease (AD) and Non-Demented Alzheimer's Disease (NDAN). This presents a captivating study involving brain activity, and oxygen levels. Through quantitative analysis of Tau-stained AD and NDAN brain tissue, we observed surviving neurons by counting and measuring size differences. We found that there is a significant difference between number and size of healthy neurons in the CA1 subregion between these two groups, showing NDAN cases having larger and greater healthy neurons. Larger number of Tau negative healthy neurons in CA1 may account for cognitive health in NDAN.

58. **Analysis of the CA4 Region in Demented versus Non-Demented Alzheimer's Individuals**

Yaman Sebai, Jose Ortiz, Ayah Elsamad, Ash Velasquez, Monalisa Parida, Consultant: Vivianne Mitri, Advisor: Glenn Kageyama

Alzheimer's Disease (AD) research largely focuses on individuals who were demented and assessed to exhibit low cognitive functioning. However, a significant number of individuals with AD histopathology are non-demented (NDAN) and have been ignored. These NDAN individuals, within their lifetime, displayed normal cognitive functioning despite the fact they were diagnosed with AD post-mortem. The means and reasoning through which these individuals live normal cognitive lives given their histopathology is unknown. This study focus primarily on the CA4 region of the hippocampus, whose function and classification is still being studied. Cell counts and measurements were taken of a variety of cases in order to determine whether NDAN individuals have a normal amount of healthy neurons. Our results indicate that the CA4 region, like other cognitive processing hippocampal regions, may have undergone neural adaptations to compensate for local neuronal loss caused by AD. Thus, revealing that NDAN patients somehow have obtained neuroprotective properties to partially compensate for AD based neurodegeneration.

59. **Reaction of Bone Marrow Stromal Stem Cells to Prosthetic Metal Ions**

Olivia Carrillo, Advisor: Steve Alas

No abstract provided

60. Using conjoint analysis to highlight the attributes of a functional food product that contains pomace from different sources

Elvis Garcia, Advisor: Gabriel Davidov-Pardo (College of Agriculture)

Pomace is the residue that is discarded from fruits that have been processed to obtain juice or wine. Every year juice companies create a mass amount of underutilized pomace which creates an economic and environmental problem. Pomace has been found to be richer in antioxidants than the juice itself, thus opening an opportunity to create functional food products. The goal of this research was to find what attributes drive the selection of a pomace enriched product using conjoint analysis and three different sources of pomace (orange, pomegranate, and olive). A conjoint survey was developed and launched. Conjoint analysis becomes a useful tool by helping to eliminate any idea that might fail in the market. 151 Participants were asked to choose between products with different characteristics that would contain pomace. Attributes were: type of day item (breakfast, lunch, snack); pomace source; taste (sweet, savory, sour); nutritional claim (high-protein, high-fiber, low-sugar); type of product (soft gel [pudding or yogurt like], solid [baked or candy like], liquid [beverage or dressing like]). The survey also included a set of demographic and supplementation behavior questions. Results showed that consumers want a was a ready to eat, candy, or baked type of snack with pomegranate pomace that is sweet and high in protein. With Pomace source, flavor, and type of products have been the most influential aspects for the consumers' decision, with 29.8, 24.4, and 18% relative importance, respectively. Ongoing research involves assessing the sensory acceptability of a snack with the most desired attributes with the three pomace sources.

CHEMISTRY AND BIOCHEMISTRY**61. Reduction of Asymmetric Auxiliary Amine(bis) phenol ligands for deoxymolybdenum complexes**
Fernando Alfaro, Advisor: Alex John

Fossil fuels are limited resources, thus finding alternative manners to produce chemical feedstock is essential to ensure their chemical supply and preservation. The use of biomass efficiently meets this goal due to its great abundance, and as a renewable resource it is greatly accessible. Although biomass mass is a great alternative for chemical feedstock production, its highly oxygenated nature requires methods, such as deoxydehydration (DODH), to obtain favorable results. The DODH approach is currently being studied due to its efficacy of removing oxygen-containing functional groups, creating an alkene compound. DODH can be utilized to generate alkenes from vicinal diols, and it can be accomplished with a reducing agent and a transition metal catalyst. A Molybdenum (Mo) transition metal will be used to for a catalyst for DODH reactions. Molybdenum (Mo) has chemical properties similar to rhenium (Rh), which is a metal typically used for DODH due to its high yield, but it is scarcer. In this study, the synthesis of asymmetric ligands and their impact on DODH reactions are investigated. The asymmetric ligand was synthesized in a multi-step process, consist of a reductive amination method, and it was used for the synthesis of a

deoxymolybdenum complex. Their characterization was completed by ¹H-NMR spectroscopy, IR spectroscopy, and X-ray crystallography.

62. Synthesis of Mesityl imidazolium salt ligands precursors for metal complexes

Romualda Aquino*, Carlos Gutierrez, Chantal E. Stieber, Advisor: Chantal E. Stieber

Ligands like bisimidazolium salt and (tBuNHC2Me)Ni(COD) are important derivatives of imidazole precursors bonded with N-heterocyclic carbenes (NHC) used for the synthesis of transition metal complexes. NHC is widely utilized within catalysis in many fields of chemistry, but specifically in organometallic chemistry. Synthesis of these ligands has been developed without robust implementation of green chemistry, cost-efficient for large-scale production, or high product yields. Synthesis of ligand precursors utilizing mesityl aniline with glyoxal to produce a bisimidazolium salt while another method was performed with a start with bisimidazolium salt. These series of syntheses are still being performed; therefore, no yield results have been produced. The next step for these ligands will be implemented to synthesize metal complexes.

63. Synthesis and Characterization of N-Heterocyclic Carbene Ligands

Briana Arreaga, Jacob P. Brannon, Advisor: Chantal Stieber

Precious transition metals, such as ruthenium and palladium, are used as catalysts in the making of pharmaceuticals and fine chemicals however, these elements oftentimes are expensive and not very Earth abundant. This has resulted in research into first row transition metals, including iron and nickel, which are more prevalent and less costly than many of the metals that are currently being used in catalysis. Nickel complexes have been synthesized where it is bounded to bidentate N-heterocyclic carbene (NHC) ligands. The NHC ligands were made by synthesizing mesitylimidazole and using it to make a bis(imidazolium)salt ligand precursor, [MesNHC2Me][Br]₂. Following addition of KHMDS as a strong non-nucleophilic base, the free ligand was reacted with Ni(COD)₂ to form the nickel complex, (MesNHC2Me)Ni(COD), which was reported by our group and crystallographically characterized. The complex was characterized by ¹H NMR and ¹³C NMR. Nickel complexes, such as this, may be cost effective catalysts alternative for a variety of chemical transformations

64. Comparative Analysis of Anions by Capillary Electrophoresis and Ion Exchange Chromatography

Estevan Arreola, Advisor: Yan Liu, Ph. D

In society, there exists a need for verifying chemical contents that exist in nature and man-made products. Because of the varying places that analytes can be found, there must exist methods that can verify the presence of desired analytes based on their differing characteristics. When two compounds vary in chemical composition but consist of similar characteristics, it is important that methods to identify those chemicals individually, exist. Compounds of Sodium Sulfate and Sodium Nitrate were analyzed by UV-vis Capillary Electrophoresis indirect detection and High-Performance Liquid Chromatography to compare the separation methods that allow for presence confirmation and quantification. Mixture standards were prepared of sodium sulfate and sodium nitrate at differing concentrations of 0.1, 0.4, 0.7, and 1.0 millimolar. In addition, standards of

sodium sulfate and sodium nitrate were also prepared separately, following the same concentration pattern to confirm elution time. It was found that in the mix of the two constituents, both compounds co-eluted using both instruments, which made it difficult to confirm the presence of the two compounds. Capillary electrophoresis was found to consist of a baseline that can create problems when integrating because of baseline fluctuations. Although both were successful in confirming the presence of sulfate and nitrate, the better of the two instruments was identified to be the UV-vis HPLC instrument. Modifying the instrument to achieve clearer resolution yields cleaner chromatograms when compared to the electropherograms of the capillary electrophoresis instrument. In the modern era, the accuracy of quantitative analysis has grown in importance due to regulatory and product demand reasons. When performing analysis on these compounds, this comparison proves useful in determining the correct method based on chemical characteristics.

65. COMPUTATIONAL STUDY OF BIDENTATE N-HETEROCYCLIC CARBENE NICKEL COMPLEXES

Nicole Danielle Avila, Advisor: S. Chantal E. Stieber

N-heterocyclic carbenes are exceptionally important to study. They work as powerful ligands for transition metals because of their σ -donation and transition metals ability work as powerful σ -acceptors. NHCs form Bidentate NHCs, which are a formation of two NHCs. Bidentate NHCs allow for coordinative flexibility. Computational studies of bidentate NHCs can provide insight into the electronic structures and mechanisms for oxidative addition reactions. The mesityl variant, ((η 4-cyclooctadiene)(3,3'-dimesityl-1,1'-methylenediimidazole-2,2'-diylidene)nickel(0) tetrahydrofuran monosolvate, and a variant with a NO ligand replacing the COD ligand are investigated providing a computational analysis of a newly reported compound and a variant. The computational analysis determined a structure that was compared to the reported crystal structure. The geometry optimized coordinates of the structure were utilized for further DFT calculations in which various spectroscopies were determined. Using the XSEDE Comet Compute Cluster from the San Diego computing software, and the ORCA software version 4.2.1 for windows, density functional theory calculations and spectroscopy were determined. The Avogadro program was utilized to obtain every atom's coordinates using the CIF file from the crystal structure of ((η 4-cyclooctadiene)(3,3'-dimesityl-1,1'-methylenediimidazole-2,2'-diylidene)nickel(0) tetrahydrofuran monosolvate by Yanamoto et. al.

66. Investigation of thiohydroxamic acids as potential HDAC6 selective inhibitors, anti-cancer agents

Yasmine Naffaa, Lauren Bradford, Advisor: Adaickapillai Mahendran

Transcription in cells is regulated through acetylation and deacetylation of histone proteins, in which HDAC enzymes play a large role in the deacetylation of lysine residues. HDAC enzymes are found in elevated levels in cancerous cells, making them a great target in cancer therapy through the use of HDAC inhibitors (HDACi). Current HDACi, such as Vorinostat (SAHA), Belinostat, and Panobinostat, contain the hydroxamic acid functional group which lacks selectivity and demonstrates toxicity. Selective inhibitors of the HDAC6 enzyme include HPB and HPOB, however they are still subjected to carcinogenic effects by mutating DNA from the toxic intermediate

isocyanate, formed by the Lossen rearrangement. The objective is to study and develop thiohydroxamic acids as selective HDAC6 inhibitors. To better understand the binding properties of thiohydroxamic acid functional groups with metal (Fe, Zn, Cu, Co, and Ni) ions, a series of thiohydroxamic acids have been synthesized and characterized by NMR and LC/MS. Infrared spectroscopy is utilized to identify the thiocarbonyl bond in 4-nitrobenzothiohydroxamic acid. Furthermore, current UV-Vis spectroscopy and infrared spectroscopy studies were performed to compare the binding abilities of thiohydroxamic acids to hydroxamic acids, in which preliminary studies show great binding nature of SAHA to Fe³⁺ and Cu²⁺. This presentation will review crystal structures and metal complexations of SAHA and discuss the synthesized thiohydroxamic acids.

67. Investigation of benzylic alcohol oxidations using molybdenum catalysts

Ivy Wang, Eunice Castro, Advisor: Alex John

The conventional reagents used in alcohol oxidation reactions pose severe economic and environmental consequences. Nevertheless, such reagents are still heavily relied upon due to the fundamental role of alcohol oxidations in the chemical processes used by various industries, such as pharmaceutical and biofuel industries. Therefore, with sustainability in mind, this project intends to examine alternative methods for these reactions via novel molybdenum catalysts. Due to a lack of literature surrounding transition metal catalyzed alcohol oxidations, the mechanistic role of each component will be thoroughly investigated through an evaluation of the oxidation of a diverse range of alcohols including primary, secondary, benzylic, allylic, and aliphatic alcohols. In the process, the electronic, steric, and backbone effects of the molybdenum catalysts as well as the optimal reaction conditions are also to be assessed in this work. The reaction conditions of the standard alcohol oxidation method in this work consists of a 24-hour reaction time and a reaction temperature of 120°C. The procedure also utilizes a 2 mol% equivalent of the synthesized molybdenum catalyst and 100 mol% of the alcohol substrate in the presence of dimethyl sulfoxide, which acts as both the solvent and oxidizing reagent. As a result, the conversion yields of the catalytic alcohol oxidation reactions can be observed to vary from 20% to 98% based on the alcohol substrate used.

68. Synthesis and Structural Characterization of a Bidentate N-heterocyclic Carbene Nickel

Complex: (MesNHC2Xy)Ni(COD)

Ethan B. Chavarin*. Jacob P. Brannon, Neil Dudeja, S. Chantal E. Stieber, Advisor: S. Chantal E. Stieber

Bidentate NHC nickel complexes (RNHC2R1)Ni (R, R1 =alkyl, aryl) have been used in a variety of catalytic applications such as cross couplings, alkane oxidation, and photocatalysis. In this work, a less widely studied ligand precursor [MesNHC2Xy][Br]₂ (Mes = 2,4,6-trimethylphenyl; Xy = xylyl) was synthesized by reacting mesityl imidazole (MesIm) with 1,3-bis(bromomethyl)benzene. [MesNHC2Xy][Br]₂ was then deprotonated with potassium bis(trimethylsilyl)amide (KHMDs) in THF, forming the two free carbenes. Ni(COD)₂ (COD = cyclooctadiene) reacted with the carbene ligand, forming a new nickel complex, (MesNHC2Xy)Ni(COD), which was characterized by ¹H NMR spectroscopy. (MesNHC2Xy)Ni(COD) was also structurally characterized using single crystal X-ray diffraction. The xylyl aryl ring in the middle of the complex creates more spacing between the free

carbenes, generating a more flexible ligand. The (MesNHC2Xy)Ni(COD) pre-catalyst is currently being tested for NO_x and C-F activation.

69. **Cyclic Dipeptide Synthesis: Module Design**

Jessica Alexandra Coronel, Kimchou Lao, Advisor: Thomas Osberger

A laboratory module for the synthesis of cyclic dipeptides was designed aimed toward students in an organic synthesis lab. An annotated bibliography of cyclic dipeptides candidate experiments was compiled through searching literature articles on Sci-finder. The scope of the articles focused on homocyclic dipeptides including cyclo(ala-ala), cyclo(phe-phe), cyclo(pro-pro). A cost estimation, chemical hygiene and safety, ease of completion, including time of completion, ease of purification, and characterization were evaluated to construct a shortlist of possible experiments to be conducted in the laboratory. An analysis on the shortlist of possible experiments narrowed down to the one-step phosphorous trichloride reaction. A pilot experiment using phosphorous trichloride and L-phenylalanine proved to be successful in the synthesis of cyclo(phe-phe). The students successfully synthesized cyclo(phe-phe), but the synthesis of cyclo(pro-pro) proved to be unsuccessful.

70. **Clostridium scindens: Modifying bile acids of primary importance. The role of BaiCD in secondary bile acid metabolism.**

William A Cruz, Advisor: Advisor: McCulloch

Abstract

Clostridium scindens, which is found in the gut, produces a set of enzymes that metabolize primary bile acids to cancer inducing secondary bile acids. These enzymes are products of *C. scindens*' bai operon. One enzyme, BaiCD, is a dehydrogenase whose structure and mechanism is yet to be resolved. The current goal of this study is to utilize bioinformatics to determine conserved sites and to also determine optimal purification steps. By using bioinformatics, four conserved iron-sulfur clusters and an active site were observed. Purification was completed using immobilized metal affinity chromatography (IMAC), size exclusion chromatography (SEC) and anion exchange chromatography (DEAE). A higher efficiency was observed when using IMAC coupled with SEC.

71. **Overview of using OLEX2 with a published dataset for learning structure determination by x-ray crystallography**

Caitlyn Cruz, Advisor: S. Chantal E. Stieber

X-ray crystallography is an experimental method that has been crucial in the determination and visualization of 3-dimensional atomic structures. Researchers are able to accomplish both solution determination and data refinement of a given complex with experimental data files collected from an X-ray diffraction experiment. Here, we highlight the process of structure determination using the free X-ray crystallography program OLEX2 and a published dataset. Once the data refinement and structure determination is completed, the researcher will analyze the standardized crystallographic information file (CIF) produced at the end. This will be checked through the ICUR

Check CIF website which will flag many potential issues found in the CIF. These must then be corrected by the researcher in order to finalize the file for submission to the CCDC repository and publication.

72. **Structural Determination of Cyclobutane Carboxamides**

Neil Dudeja*, Dani Rodriguez, Prof. Thomas J. Osberger, S. Chantal E. Stieber, Advisor: S. Chantal E. Stieber

Cyclobutane-carboxamide derivatives have various biological and chemical properties, most notably in the inhibition of metabolic pathways and use in pharmaceutical medicines. The compounds synthesized in this work contain a cyclobutane group with heavy ring strain and attached functional groups (R groups) of either an alcohol or ketone. This work examines structures of newly synthesized cyclobutane-carboxamide derivatives. X-ray crystallography is commonly used to determine 3-D structures of chemicals ranging from organic molecules to inorganic substances. Crystal structures can be used to determine intermolecular and intramolecular characteristics, notably bond lengths, angles, physical distances, and more. The OLEX2 program was used along with the SHELX(T) program, to determine the structures of several cyclobutane-carboxamide derivatives. The general procedure included synthesizing molecules, crystallization & purification of products, X-ray diffraction experiments, structure determination and refining the structure, integrating data, finding the unit cell, and checking for data discrepancies with IUCr. Future work includes using X-ray crystallography to determine other structures of organic molecules made from unique synthetic methods.

73. **Examining catalytic reactions with Vanadium sources and a study of β -O-4 bond cleavage**

An Quoc Duong, Advisor: Alex John

Fossil fuels are crucial energy sources in our daily lives. However, it is finite and faces depletion due to excessive usage. Also, non-renewable such as oil, coal, and natural gas lead to global warming through CO₂ emissions. Lignin, biomass from the cell wall, not only solves the environmental problem but also provides a renewable energy source. High aromatic content makes them become a great alternative to non-renewable fossil resources. However, it is difficult to break into small molecules due to their amorphous structure. β -O-4 is the most common linkage of lignin (50%). In this project, the study of β -O-4 cleavage in catalytic reactions is performed under the presence of Vanadium catalysts. The reaction temperature and time help optimize to identify the best condition. Steric and electronic effects also play a role in catalytic reactions. Various ligands and complexes were studied at 100°C and 140°C. Future works focus on examining the reaction outcomes at 120°C.

74. **Development of a Video Tutorial to Teach Students Research Notebook Formatting**

Carlos Gutierrez, Romualda Aquino, Advisor: S. Chantal E. Stieber

There is oftentimes a high learning curve for undergraduates beginning an independent research project that is oftentimes dependent on highly individualized training. The goal in this work was to introduce fundamental laboratory techniques and etiquette for students joining research groups

in a more streamlined fashion through video tutorials. These videos review fundamental topics of understanding before coming into research laboratories, such as laboratory notebook etiquette, correctly reading a scientific notebook, reviewing safety hazards, using specialized software, and setting up reactions. In addition, these videos can easily be referenced for students to continuously review when needed and be used as a tool to be successful in their research experience.

75. **Synthesis and Evaluation of Bisbenzylisoquinoline Compounds**

Jeanney A. Munoz, Samantha E. Hernandez, Advisor: Thomas J. Osberger

Worldwide diseases that affect the world population causing millions of deaths annually are due in part to treatments that are losing their effectiveness, have significant negative side effects, or have no treatment at all. The family of Bisbenzylisoquinoline (BBIQ) natural products may provide an effective starting point for new and/or preventable treatments for the parasitic disease leishmania and the global pandemic disease Covid-19, but the methods for their synthesis are limited. These BBIQs are macrocyclic compounds containing two benzyl-substituted tetrahydroisoquinoline rings connected through diaryl ether linkages. Many synthetic studies have been conducted; however, no systematic studies have been performed to determine how these molecules exhibit their biological activities including antiparasitic, anti-inflammatory, and antiviral activities. The intent of this study is to read upon the literature reports of Tetrandrine synthesis, a BBIQ core, in order to understand the background information on how others produced this natural product. This can be used as a comparison to Cepharanthine, a BBIQ known to inhibit the SARS-CoV-2 virus. With that information, a double Pictet-Spengler reaction is to be used in order to provide this natural product. This study has the ability to provide compounds that are useful in the long-term goal to find new and/or preventable treatments for worldwide diseases.

76. **Synthesis of Bis(imidazolium) Salts from Bifonazole and Anilines**

Dinh Ho, Advisor: Chantal Stieber

Due to human activities, the amount of greenhouse gases and pollutants such as NO, NO₂, and N₂O is increasing significantly. In this study, the ligand salt was synthesized and reacted with dibromomethane (CH₂Br₂) and toluene (C₇H₈) in a reflux reaction to give three new bis(imidazolium) salts complexes that had never been generated before. These complexes were characterized by H-NMR and recrystallized with methanol. All these reactions can provide an insight into understanding the mechanism of pollutant reduction.

77. **Deoxydehydration of Vicinal Diols using Microwave Irradiation**

Paul M. Lam, Advisor: Alex John

The Deoxydehydration is a useful reaction which converts vicinal diols into their respected olefin. It provides a potential pathway to platform chemicals which would otherwise be derived from non-renewable resources such as fossil fuels. Our group is focused on using Molybdenum and Vanadium based catalysts to perform the DODH reaction. However, they require optimization to

perform decently relative to Rhenium, an ongoing endeavor in our lab. Taking advantage of microwave irradiation's efficient transfer of heat, the goal would be to change reaction conditions to increase yields and decrease reaction times, relative to conventional heating methods. Currently, using styrene glycol as a benchmark reagent, reaction rate has improved using irradiation. Full conversion occurs around 40 minutes compared to traditional heating methods such as oils baths or refluxes which require hours per reaction. However, yield of desired product is dependent on the solvent used with fossil fuel derived nonpolar organic solvents being the most efficient. The next steps would be to phase out using such benchmark reactants in favor of more biofriendly substrates. Biomass has an abundance of oxygen functional groups which could be used in DODH. Using common sustainably sourced vicinal diols such as erythritol would be preferred. Furthermore, investigation into environmentally friendly solvents is desired. Microwave irradiation has potential to improve DODH and using the array of catalysts made available by our group, hopefully the process can be applicable to further research in green chemistry.

78. The Stereocontrolled Synthesis of Cyclobutane-based Fragment Library

Kimchou Lao, Dani Rodriguez, Neil Dudeja, Thomas J. Osberger*, Advisor: Chantal Stieber

Cyclobutane rings are important structural elements of small-molecule pharmaceuticals and other biologically active molecules. However, the synthesis of stereochemically defined cyclobutane compound collections remains a significant challenge, leading to cyclobutane structures being underrepresented in commercial compound collections. This project focuses on the stereocontrolled synthesis of a cyclobutane-based fragment library. Starting from 3-oxocyclobutane carboxylic acid, amide formation was performed, followed by ketone derivatizations such as Reduction, Reductive amination, and Wittig reaction to construct a family of functionalized cyclobutane carboxamide compounds. The use of an 8-aminoquinoline amide enabled Pd-catalyzed C-H arylation on some cyclobutyl derivatives, leading to trisubstituted cyclobutane compounds. Different substrates and a variety of aryl iodides were evaluated for the arylation reaction, and the reactions will be optimized after finding the most efficient substrate. Single crystal X-ray diffraction has confirmed the structures of several products. Our efforts thusfar have furnished a molecular collection that is suitable for screening for antibacterial and further biological activities.

79. Synthesis of N-Heterocyclic Carbene Lanthanide Complexes

Christian LeRue, Advisor: Chantal Stieber

Advancing knowledge of octahedral coordination chemistry in lanthanides can lead to an understanding of how actinides bond to atoms and ultimately help with radioactive waste management. Lanthanides and actinides can have similar bonding and coordination behavior, which allows for the study of coordination chemistry of lanthanides to apply the theory to actinides. N-heterocyclic carbene (NHC) ligands are of particular interest for studying bonding with f-elements because of the strongly sigma donating carbene. Bidentate N-Heterocyclic carbene ligands (NHC₂) are known to coordinate to a range of transition metals, but lanthanide complexes are not known. In this study, [tBuNHC₂Me][Br]₂ (tBu= tertbutyl, Me= methylene) was deprotonated with potassium bis(trimethylsilyl)amide (KHMDs) in diethyl ether to create two

reactive carbenes. The free carbene ligand (tBuNHC2Me) was reacted with anhydrous CeCl₃ and LaCl₃, isolated, and characterized by ¹H NMR spectroscopy. The resulting complexes are Ln(III) complexes and further characterization with electrochemistry and crystallography is underway. Studying coordination chemistry of f-block elements can lead to further advancements for catalysts and understanding bonding with f-elements.

80. **Synthesis of bis(imidazolium) salts with modified para-aryl substituents**

Hellen D. Marin*, Advisor: Chantal Stieber

Bis(imidazolium) salts are critical ligand precursors for stabilizing a range of metal complexes and catalysts. In this work, commercially available imidazole precursors were reacted with dibromomethane to make new bis(imidazolium) salts with a variety of functional groups. Phenyl imidazole precursors with electron withdrawing and donating groups were used and the products were characterized by ¹H NMR.

81. **Homology Model and Protein Purification of the Enzyme BaiK for Structural and Mechanistic Studies**

Carolina Mata, Roman Aguirre, Stephen Khuu, Advisor: Kathryn McCulloch

Primary bile acids play a major role in digestion by assisting in the absorption of fats and oils entering the body. Once in the gastrointestinal tract, naturally occurring gut bacteria such as *Clostridium scindens* convert primary bile acids into secondary bile acids via a pathway encoded by the bile acid inducible operon, which includes a putative coenzyme A transferase enzyme, BaiK. Pre-COVID, a recombinant approach using *E. coli* was chosen to characterize BaiK. First, the *E. coli* Tuner expression line was transformed using a plasmid containing the baiK gene for overexpression. Large-scale overexpression was used to obtain large quantities of the protein, and the resulting cell pellet was collected for purification via column chromatography. Protein purification strategies have been optimized. Challenges in purifying larger amounts of protein to yield a single peak in chromatograms were circumvented by performing both affinity and gel filtration chromatography on the same day to avoid aggregation. The concentrated protein will next be used in crystallization screenings. Homology modelling studies were used to obtain a hypothetical BaiK structure, which can help determine function and characteristics. This was done using available web-based tools such as BLAST, SWISS model, EXPASY, and Xtalpred. These servers were used to convert the genomic sequence to a protein sequence, remove the histidine tag using enterokinase, and align the sequence with published structures of PDB proteins. After investigations based on sequence similarity, conserved areas, and proposed function, multiple proteins were selected as templates for BaiK's homology model. The model was generated using SWISS model, which generated a homo dimer model consisting of a 37% sequence identity. The model had a favorable QMEAN score, with highly conserved areas in the active site. Verification of the model was achieved using the built-in functions from SWISS model.

82. **Synthesis of Bidentate N-Heterocyclic Carbene Cobalt Dinitrogen complexes with Xylyl Linkers**

Mei L. Matsumoto, Advisor: Chantal Stieber

N-Heterocyclic carbenes (NHC) have been used to advance catalysis due to their strongly sigma donating abilities for coordinating to a variety of metals. Cobalt NHC complexes are used as catalysts for a variety of reactions such as the hydrogenation of hindered alkenes. However, bidentate NHC2 ligands containing first row transition metals remain less widely studied and are generally limited to nickel and iron. A ligand precursor with a *o*-xylyl linker was synthesized by reacting mesityl imidazole (MesIm) with 1,2-bis(bromomethyl)benzene, producing [MesNHC2Xy][Br]₂ (Mes = 2,4,6-trimethylphenyl; Xy = xylyl). The addition of the *o*-xylyl creates more space between the carbenes, allowing for an aryl group to be added which generates the possibility for better crystallization. The ligand precursor was deprotonated with potassium bis(trimethylsilyl)amide (KHMDs) in THF to create a bidentate carbene ligand that was reacted with CoCl₂ to form a new cobalt complex, (MesNHC2Xy)CoIICl₂. The reduced cobalt dinitrogen complex, (MesNHC2Xy)CoO(N₂), was synthesized by reacting (MesNHC2Xy)CoIICl₂ with 2 equivalents of sodium metal, catalytic naphthalene, and THF. This product was characterized by IR spectroscopy to confirm the presence of the Co-N₂ bond. These are new cobalt complexes with NHC2 ligands and they are currently being investigated for NO reduction and catalysis.

83. **Synthesis and Evaluation of Bisbenzylisoquinoline Compounds**

Thomas J. Osberger, Jeanney A. Munoz, Samantha E. Hernandez, Advisor: Thomas J. Osberger

Worldwide diseases that affect the world population causing millions of deaths annually are due in part to treatments that are losing their effectiveness, have significant negative side effects, or have no treatment at all. The family of Bisbenzylisoquinoline (BBIQ) natural products may provide an effective starting point for new and/or preventable treatments for the parasitic disease leishmania and the global pandemic disease Covid-19, but the methods for their synthesis are limited. These BBIQs are macrocyclic compounds containing two benzyl-substituted tetrahydroisoquinoline rings connected through diaryl ether linkages. Many synthetic studies have been conducted; however, no systematic studies have been performed to determine how these molecules exhibit their biological activities including antiparasitic, anti-inflammatory, and antiviral activities. The intent of this study is to read upon the literature reports of Tetrandrine synthesis, a BBIQ core, in order to understand the background information on how others produced this natural product. This can be used as a comparison to Cepharanthine, a BBIQ known to inhibit the SARS-CoV-2 virus. With that information, a double Pictet-Spengler reaction is to be used in order to provide this natural product. This study has the ability to provide compounds that are useful in the long-term goal to find new and/or preventable treatments for worldwide diseases.

84. **Optimization of High-Performance Liquid Chromatography Flow for Acetaminophen Analysis**

Robert Nelson, Advisor: Yan Liu

Acetaminophen (N-(4-hydroxyphenyl) acetamide, C₈H₉NO₂, or commercially known as Tylenol) is a popularly used drug for mild to moderate pain relief, muscle aches, colds, fever relief, and many other applications. Other popular over-the-counter painkiller medicines include Advil, Motrin, and Aleve which are examples of nonsteroidal anti-inflammatory drugs. This project is to develop a separation method to analyze acetaminophen.

Optimization of the mobile phase was determined by varying the ratio of acetonitrile (ACN) and water of the mobile phase to produce the highest plate number in the HPLC separation. Nine trials were tested to determine the highest plate number, starting at a 10% ACN and 90% H₂O mobile phase and increasing the ACN by 10% until the mobile phase was 90% ACN and 10% H₂O. Through the construction of this curve, it was determined that a 50:50 ratio of ACN to H₂O provided the highest accepted plate number of 147.1. A calibration curve of acetaminophen was then constructed via separations of various concentrations of acetaminophen. The calibration curve was determined to be representative of data with an R² value of 0.9958.

Overall, an HPLC optimal flow was determined in the separation analysis of acetaminophen. The developed method can be applied to other painkiller analyses with proper modification and monitor the decomposed byproducts of painkillers.

85. **Synthesis of Substituted Isatins as Potential Agents**

Timmy B. Nguyen, Nathalie Nalbandian, Joanna Feng, Advisor: Thomas J. Osberger

Indole-1H-2,3-dione, most commonly known as isatin, is a heterocyclic compound with significant synthetic versatility due to its highly reactive C-3 carbonyl group and N-1 amino group whose derivatives can serve as precursors for potential antibiotics and pharmaceuticals. The unique properties of isatin's structure lends it to undergo a broad variety of structural modifications to synthesize structurally diverse derivatives and yield a large spectrum of biological activity. Previous studies show numerous derivatives that possess antimicrobial, antiviral, and anticonvulsant properties that allow for a wide array of compounds to be synthesized. Many of the synthetic routes involve the production of substituted isatins at positions C3, C5, C7, and N-alkylation reactions. Numerous journal articles observed the greatest antimicrobial activity when substituted at C3 and C5 positions with electron-withdrawing groups due to its increased lipophilic character to facilitate transport across the hydrophobic membrane. Herein, we report the synthesis of a library of substituted isatin derivatives to investigate the effects of various substitutions on the C3 carbonyl and the halogenation of the aromatic ring on the antibacterial properties. The synthesized derivative compounds will be screened against E. coli for potential antimicrobial activity.

86. **Spectroscopic Analysis of Acetaminophen and Salicylic Acid in Over-the-Counter Pain Medication**

Levi J Henderson, Advisor: Dr Yan Liu

Many Painkillers can degrade over time. In Order to determine the composition of a specific medication UV-Vis can be used. Different ingredients both active and inactive have unique absorption wavelengths. In the case of Acetaminophen by obtaining a linear curve of absorbances at its absorption wavelength with varying concentrations of a pure, known amount. a trendline equation can then be used to predict the concentration present in a sample of unknown medications. This process can theoretically be adapted to other compounds as well including byproducts of degradation such as salicylic acid in aspirin.

87. **Metabolite Profiling the Inhibition of Root Growth Under Aluminum Stress**

Rachelle Rivera, Advisor: Gregory A. Barding

Aluminum toxicity has impacted crop plants by root growth inhibition. The process in which root growth is inhibited is under exploration. Recently, there has been several general discoveries regarding the biochemical processes of the aluminum stress is mitigated by plants. Aluminum toxicity is a prime factor in restricting plant manufacturing on acid soils. Currently, in the research lab, different mechanisms are being applied to understand the reactions the plants have with aluminum toxic soils. Root growth inhibition is explored by applying gas chromatography-mass spectrometry (GC-MS) to analyze the stress corresponding to the aluminum toxicity. To understand the reaction of crop and aluminum toxicity, a sensitive selected ion monitoring (SIM) method is involved to identify metabolic effects. Furthermore, the SIM method is able to measure 15 metabolites and allows the addition of many more. By using the SIM method and applying GC-MS, exploring the inhibition of root growth has advanced and allowed for an understanding of aluminum toxicity effects through different mechanisms.

88. **The Stereocontrolled Synthesis of Cyclobutane-Based Fragment Library**

Patricia Rodriguez, Kimchou Lao, Neil Dudeja, Advisor: Thomas J. 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, amide formation was performed, followed by ketone derivatizations such as Reduction, Reductive amination, Oxime formation, and Grignard 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 12 cyclobutane caboxamide compounds has been synthesized and in future studies will be evaluated for antimicrobial properties.

89. **Optimal Temperature for *Acinetobacter radioresistens* 50v1 Growth in Spacecraft Clean Room Conditions**

Morgan N. Saunders, Amanda J. Ochs, Juan Aldaco, Daniel S. Jaramillo, Advisor: Rakesh Mogul

Acinetobacter radioresistens 50v1 is a Gram-negative bacteria, specifically noted for its ability to survive in nutrient-poor conditions. Microbes such *Acinetobacter*, have become an obstacle of contamination during spacecraft assembly. Any contaminates have the ability to go through extraterrestrial evolution or hinder the functionality of the spacecraft once launched. On the preflight of the Mars Odyssey orbiter, *A. radioresistens* 50v1 was found on the surface of the spacecraft, surviving various trials of extermination. *A. radioresistens* 50v1 has been found to have

a logistic growth pattern in room temperatures, ranging from 26°C to 32°C, in the presence of aqueous ethanol and low osmolarity media (0.2x M9). There is still more to be found about the temperature range in the presence of these conditions, as all temperatures within this range exhibited a stable growth rate. With ethanol serving as the sole carbon source for the growth of this bacterium; this cleaning reagent could be the possible explanation for *A. radioresistens* 50v1 survival in spacecraft clean rooms.

90. A Study of the Oxidative Cleavage of Lignin Model Compound Using Vanadium Catalysts

Haruka Takenaka, Advisor: Alex John

Petroleum is the main source of chemicals and energy in this society. However, it is estimated that it runs out in this century since it is non-renewable and highly demanded. Biomass is the only renewable source of organic molecules, and the valorization of biomass as a source of chemicals is becoming more attractive. Lignin is a complex organic polymer found in plant cell walls and has a potential of becoming an alternative to petroleum if it is efficiently cleaved. However, due to the structural complexity, it is difficult to cleave lignin efficiently. Previous studies found that the vanadium catalyst is a good candidate to catalyze the cleavage of the bonds that are commonly found in the lignin structure. In this study, the oxidative cleavage of the lignin model compound using vanadium catalysts was studied to determine the electronic and steric effects of the ligand backbone of the vanadium catalysts. In addition, the effect of catalyst loading was studied to approach a greener and more efficient method.

91. An Analytical Study of the Orthophosphate and Nitrate Levels of Cal Poly Pomona's Duck Pond

Abigail Trujillo, Advisor: Gregory Barding

The main goal of this project is to establish a water monitoring protocol to quantify nitrate and phosphate levels of the duck and turtle pond at Cal Poly Pomona. High levels of nitrates and phosphates can lead to increase levels of algae. Algae growth decreases dissolved oxygen and increased the turbidity, adversely affecting the health of the pond animals. The protocol will be based off protocols established by the E.P.A. in 1997. The first phase of this project will be to quantify the orthophosphate levels in the pond. Once the reagents have been purchased, a triplicate of calibration curve will be created using standards and the absorbance readings on the spectrophotometer. Afterwards, samples will be collected from four different points in the pond. The phosphate standards will be fixed or treated with molybdate and then reduced with sodium sulphide in aqueous sulfuric acid, converting all phosphates into orthophosphates. The orthophosphate absorbances will be measured in a spectrophotometer. The results will be compared to the calibration curve. Subsequently, sample collection and analysis will resume to determine the stability of the phosphate levels as temperature changes. The second phase of the project will involve the analysis of nitrate levels in the pond. Similar to phase 1, a calibration curve will be created from standards. Collected samples collected will be treated with copper-cadmium granules to reduce all nitrates to nitrites. The concentration from each sample will be determined from the curve. The expected outcome of this study will be a comprehensive quantification of the phosphate and nitrates in the pond. With this information, we will be better able to create a plan

to mitigate algae growth through regulation of nitrate and phosphate levels in the pond.

92. Synthesis of Molybdenum Catalysts for Deoxydehydration of Vicinal Diols

William Gramajo, Diem Vu, Advisor: Alex John

The dependency on fossil fuels, a non-renewable energy source, often used in industrial applications such as the manufacturing of plastics and directly impacts our economy. Fossil fuel directly impacts the environment by accelerating climate change and consequently having long term effect on the ecosystem. Conversely, a tangible solution is the use of biomass, a renewable and abundant source, as a possible substitute to fossil fuels and all its associated industrial applications. In this research study, we utilize deoxydehydration (DODH), a deoxygenation reaction that removes two adjacent hydroxyls ($-OH$) groups from vicinal diols to generate alkenes. Alkenes can be used as a feedstock for making materials originated from fossil fuels like plastic, polymers, and solvents. We synthesized a series of Oxo-Molybdenum complexes used as catalyst for the synthesis of unsaturated hydrocarbon compounds. DODH of vicinal diols allows us to study the catalytic conversions by interchanging the backbone of Oxo-Molybdenum complexes with electron withdrawing and electron donating groups. In addition, DODH allows to study temperature dependent reaction, and solvent compatibility. By performing these substitutions, studies have demonstrated how electronic and steric effects, temperature dependency, and solvent availability can optimize the most efficient conditions for unsaturated hydrocarbons.

93. The Synthesis of Bis(imidazolium) Salts with Electronic Modifications

Kimberly Olivares, Advisor: Chantal Stieber

Bis(imidazolium) salts are common precursors for ligands that can stabilize metal catalysts. They are relatively easy to synthesize from imidazoles and dihaloalkanes in an overnight reflux, although yields vary. In this work, commercial imidazoles with various substituents were tested in the synthesis of three new bis(imidazolium) salts. Imidazole precursors included methyl 4-(1H-imidazol-1-ylmethyl)aniline, methyl 4-(1H-imidazol-1-ylmethyl)benzoate, and 1-methyl-1H-benzimidazole-5-carboxylic acid. All three reactions yielded new products, which were characterized by 1H NMR. These represent new bis(imidazolium) salts and will be tested for use as new ligands.

COMPUTER SCIENCE**94. An Implementation of Board Game Betrayal at House on the Hill**

Javier Angeles-Robles, Advisor: Markus Eger

Board games, an area of the entertainment industry that has brought enjoyment to many throughout the generations, today video games popularize the attention of many leaving behind these games that today's games derive their inspiration from. Previous research has shown that board games appeal to people due to the nature of gameplay and storytelling, but these games remain 3D only to be played at a table. The board game Betrayal at House on the Hill is a game

with a large fandom, it can expand its audience through the popular video game industry however following its 2004 release has not shown any such development. The purpose of this project is to analyze and develop the components that go into creating a digital version of this storytelling board game and understand why it has avoided this industry. Working to recreate this board game meant implementing board positioning with a tilemap grid and rendering it to the screen, character selection and movement, character and monster traits, user interface, mouse coordination and triggers through the use of vectors and camera aligning, scene management, scripts, public list of sprites to filter, transform sprites, rendering of sprites, gameplay, booleans, prefabs, 2D box colliders, player conditions for victory, conditions for defeat, just to name a few and many other components all went into attempting to recreating this board game into a video game. Due to the scope of the game, several components have yet to be implemented in the system at this time and because of this it remains to be seen how successful a digital adaptation of a story-driven board game can be realized, and further work will be done to reach the completion of the project.

95. **Detecting Hidden Information in PlayerUnknown's Battlegrounds**

Jorge Aranda, Advisor: Markus Eger

Video games as an industry continue to become increasingly popular. Many people enjoy playing video games and there are competitive scenes for many games. These competitive scenes include in-game ranking systems and eSports. eSports is a rapidly growing industry where players compete in different tournaments to win a prize pool. In addition, there is a collegiate eSports scene. Collegiate leagues are played between different colleges where they also compete for a prize pool. Some colleges even offer scholarships to their players. With so much money at stake as well as ranking systems in-game, it gives many players an incentive to cheat in order to gain an edge over their opponents.

Many different hacks have been developed since the advent of video games. Some of these hacks include wallhacks, aim-bots, and lag switches. There have been many different techniques in order to detect these hacks based on anomalous behavior or a debugging software that runs on the clients-machine. These detection techniques all directly observe the game, however, attacks that passively observe the game are vastly understudied. This project aims to focus on this type of cheating. In order to achieve this, my goal will be to determine whether there is a correlation between network traffic observed during game play and any information that should be hidden to the players, such as player position.

96. **BizMC: A Lua Framework for running Monte Carlo Tree Search in the BizHawk emulator**

William Armstrong*, Advisor: Markus Eger

Turn-based strategy (TBS) video games are a promising target for Artificial Intelligence, in particular the Monte Carlo Tree Search (MCTS) and its variants. However, even among this subgenre games can vary greatly in their gameplay mechanics: the online game repository MobyGames lists over 600 TBS titles. In order to feasibly perform a MCTS on such a game, it typically becomes necessary to run them in an emulator allowing for the game logic to be sped up

to a rate much greater than normal, allowing for faster analysis of game states. However, it still becomes necessary to manually define the search state on a game-by-game basis: that is, to define multiple possible game states, be able to identify (through visual analysis of the game screen or by analyzing game memory) which state the game is currently in.

The open-source emulator BizHawk contains "cores" for emulating dozens of different consoles and features integration with Lua scripts that can control input to the game as well as save and load "save states", snapshots of gamestates: this is an important detail for games with deterministic logic (that is, games in which the same outcome is always achieved from the same set of actions), as it saves crucial processing time by allowing the algorithm to associate a savestate with each node as it is expanded, allowing for any future traversal to that node to simply load the associated savestate rather than needing to execute the same actions.

97. **VR Carnival Games**

Jihyun Lee, Joshua Barrientos, Kyle Townsend, Shane Dirksen, Kyle Ullum, Advisor: Markus Eger

This project simulates a Carnival in VR and adds to the experience with increased immersion. The player must physically move their hands by using the controllers in order to play and win the games. Games that will be implemented include balloon toss, whack-a-mole, ring toss, bowling, and a shooting range.

98. **MODELING THE IMPACT OF FAKE NEWS ON THE EFFECTIVENESS OF EPIDEMIC INTERVENTIONS USING AGENT-BASED MODELS**

Kevin Pham*, Mehaa Bhatta, Advisor: John Korah

Health policymakers utilize both cutting-edge medical research and computational models to formulate and validate health policies during the spread of communicable diseases. Epidemiologists work with policymakers to analyze the effectiveness of interventions such as masking, social distancing, and vaccination. Our ongoing COVID-19 pandemic is a reminder of the importance of epidemiological models. Health messaging is a critical component of health policy and social media is the pre-eminent platform for such messaging. However, there are limitations to the authenticity of the information on social media. Current studies indicate that false (fake) news spread about 6 times faster than true news and that messages replicate rapidly if they are targeted at relatively small numbers of influential people with large followings. People make decisions built upon the news that they receive, their own beliefs, and the knowledge they already have. Studies have also shown how a pattern of complete dependency on social media as the sole source of news can make people more likely to not comply with epidemiological interventions such as vaccination, masking, and social distancing. The ability to model the autonomous behaviors of individuals as well as their social interactions are the strengths of the agent-based models (ABMs). ABMs are a bottom-up approach to modeling that allows for defining the decision-making and other behaviors of each individual or agent in an epidemic and for observing the overall effects of disease spread. The impact of fake news on social networks and how fake news impacts the global spread of diseases is the main objective of this initial research. Our initial ABM was implemented using Repast, an ABM toolkit that manages

the flow of the simulation and the autonomous agent behaviors. We provide initial results and analysis of disease spread behaviors and discuss potential ways forward.

99. **Five Minute Personality Survey: LOGB Helping Improve Self-Esteem and Self-Concept**

Vanessa Delgadillo, Advisor: Mohammad Husain

An interactive website was created in order to improve the self-concept of individuals by allowing participants to receive positive feedback about their personal characteristics which could be shared among peers, family, and friends through a five-minute personality survey called LOGB. This website was created using AWS (to create an EC2 instance, Keypair, S3 Bucket), MySQL (to store data), Google charts, HTML Javascript, and PHP interpreter accessed through a windows server. Upon completion of the survey, the user sees their results and is able to compare their results to previous participants by seeing the added visual bar graph at the bottom of the site. The results were anonymous and only compared to the percentages of males and females that already completed the survey.

100. **Parallel Processing Designs for Machine Learning based Cybersecurity Anomaly Detection**

Shane Dirksen*, Veerbasant Reddy*, Advisor: Dr. John Korah

In 2021, it is estimated that the United States spent 60 billion dollars on cybersecurity, and it is estimated that the annual cost of cybercrime worldwide will reach over \$10 trillion dollars by 2025. Anomaly detection is a key methodology for identifying patterns that represent malicious cyber behaviors. Often, classical attack detection techniques fail to work with large multidimensional datasets. Machine Learning is a proven method at detecting anomaly patterns in these large datasets. We propose parallelization designs of machine learning based anomaly detection techniques that can deal with large and dynamic data, with a focus on decision trees and autoencoders. By incorporating parallel computing, the execution time for anomaly detection can be reduced. By implementing our method across both a supervised (e.g. decision tree) and an unsupervised machine learning (e.g. autoencoders) model, we aim to demonstrate the ability for a generalized implementation that is applicable to other ML techniques and computing platforms/architectures. Decision trees are a type of supervised machine learning that utilizes decision rules to predict a target value, and is used for both classification and regression problems. Autoencoders are a generative unsupervised deep learning algorithm used for reconstructing high dimensional input data. We will be conducting a comparative performance study by using a large, real-world dataset called the KDD Cup1999. Although both autoencoders and decision trees are effective in detecting unknown types of attacks, it takes tremendous time and effort to find the optimal model architecture and hyperparameter settings that result in the best detection performance. We seek to formulate parallel designs that can be generalized across different architectures and to work with substantial amounts of dynamic, real-time cybersecurity data under resource and time constraints.

101. **Snowdown**

Aaron K. Do*, Robert Joseph Balatbat*, Ryan L. Yan*, Theodore R. Tran*, Advisor: Markus Eger

Virtual reality is becoming more common in the consumer market as a new technology platform that is unique compared to the dominant computer, mobile, and console platforms. Creating a virtual reality experience that offers players the freedom to interact in a virtual 3D space redefines the way people consume media. To explore the possibilities within a virtual 3D space, we created a virtual reality game in Unity that allows for more immersive shooting and spawning of troops. This project is developed using the HTC Vive Pro and Oculus Quest 2 systems and Unity for cross-platform development.

102. **Deep Learning for Digital Twin of a UAV**

Clarence-Hugues Domond*, Advisor: Markus Eger

We explore the development of a digital twin of a UAV with the use of deep learning and machine learning algorithms to predict and monitor the health of the physical asset. Digital twins are powerful tools that can drive business decisions, reduce production costs, and potentially save lives. They work by fitting the asset or system of interest with sensors or IoT devices of any kind to gather data from them. That data is then preprocessed, namely cleaned, and transformed to train and validate a deep learning model for predictive maintenance or mission planification. For this project, we used a mechanical simulation software (ANSYS) to simulate a beam which represents the aircraft wing, to gather our data from. We made use of elastic strain, deformation, and stress data as features to predict the output. In this case, our library is comprised of models of beams with cracks along their length which represent the potential state of the aircraft. The main goal of this project is to create a 3D visualization of the beam in Unity, which can dynamically update based on the real-time sensor data continuously fed to it. The DL (deep learning) and ML (machine learning) models are used to select the appropriate beam deformation models to display in the visualization software.

103. **Security & Privacy Analysis of COVID-19 Google and Apple Exposure Notification Applications in the United States**

Joshua Fernandes*, Advisor: Mohammad Husain

104. **Generalizing Parallel Processing Designs for Machine Learning Based Suitability Modeling of Cash Crops in California**

Alejandro Hernandez, Nilay Nagar, Advisor: John Korah

Global demands for food production are expected to rise 70% by 2050 as the world population surpasses 9 billion. In addition to an ever-growing pressure on farmers to produce more with the same resources, climate change continues to hinder agricultural productivity. In response, statisticians, computer scientists, and GIS specialists have evolved the practice of Precision Agriculture - a strategy to utilize large-scale data and statistical modelling techniques to promote land sustainability and optimize crop productivity. A subtopic of this area is the problem of identifying ecological niches of a crop within a geographic space. Crop suitability modelling has the potential to radically improve crop production by mapping over a region each location's relative suitability for specific crop(s). With these insights, farmers may adjust their allocation of farmland and relevant resources. Specialized machine learning algorithms (e.g. Maximum Entropy) may be

used in crop suitability models to account for sampling bias inherent to the data's collection. Additionally, the satellite and other datasets used in crop suitable modeling are often enormous and may also change over time. For example, a single map of California at a 1km² resolution contains over 1.4 million pixels. Large datasets pose a challenge to traditional data-processing methods that are usually designed for serial processing and cannot scale over large computational resources. The aim of this initial research is to study and implement the generalized parallel algorithm designs for crop suitable models and deal with resource constraints. We present expected results and analysis to validate these parallel algorithm designs.

105. **Generating a Multilingual Information Retrieval Data Set Through Crowdsourcing**

Daeyoung Hwang, Advisor: Ben Steichen

As the amount of available data grows exponentially, so has the need for quick and efficient retrieval of information given a specific query. Many search engines like Google, Bing, Yahoo, etc. provide state of the art, proprietary search algorithms to retrieve results, but they are often limited to results that correspond to the language of the given query. Given the user's capabilities and preferences in various languages, multilingual search engines should return the best results regardless of whether the result matches the language of the query.

In this research, we test the feasibility of creating a multilingual dataset of queries and relevancy judgement through crowdsourcing on Amazon Mechanical Turk. First, we continue the work of a previous in-person lab to collect a query log of study participants and note the language of the query. We then create a log of translated queries and collect the results of the query searches through Microsoft Bing's API. Lastly, we perform a relevancy judgement of the collected queries and query results on Amazon Mechanical Turk and compare the results to the in-person lab to validate the results.

106. **The Anima Automata**

Lorenzo V. Cabrera*, Kayte L. Chien*, Rebecca J. Lee*, Justin M. Rebollar*, Advisor: Markus Eger

The Anima Automata is a VR game designed to teach Deterministic Finite Automata (DFAs) in a fantasy setting by allowing players to fight enemies with actions that make up the DFA's language.

107. **Drone Detection and Mitigation**

Dianne Lopez, Edwin Ly, Samuel Raumin, Tristan Scharfenstein-Montgomery, Advisor: Mohammad Husain

The consumer drone market has greatly increased due to the wide array of capabilities that drones provide. Unmanned Aerial Vehicles (UAVs) provide real-time video and image capture, along with the ability to transport goods, making them lucrative for commercial and private use. However, UAVs are also being exploited to jeopardize people's privacy and well-being. To help counter these threats, we utilize Software Defined Radios (SDRs) such as the HackRF One in conjunction with GNU Radio to detect the presence of drones. To classify the drones model and brand, data collected from SDRs and processed through GNU Radio will be used to train machine learning models. Based on the classification of the drone, we can safely land the drone through

mitigation techniques.

108. **CPP VR Lab: BugCatcherVR**

*Tran Nguyen, *Van Nguyen, *Kenneth Shuto, *Nathan Brown, Advisor: Markus Eger

A virtual reality simulation game centered around catching bugs. The player is equipped with a net for catching various types of bugs to fill up your bug log. The player can keep bugs to show off or sell them for money to buy items that'll help them throughout the game. One of the player's main tools is their net, which the player is capable of grabbing and swinging in order to catch bugs. The player also has access to various debris in the environment, which the player can throw or swing at bugs to slow or damage them. The value of a bug depends on its condition. Damaged or slain bugs are easier to catch, but will have less value as a result. Bugs have many behaviors and movement patterns depending on the environment and type of bug.

109. **An Empirical Evaluation of the Implementation of the California Consumer Privacy Act (CCPA)**

Trong Nguyen, Advisor: Mohammad Husain

On January 1, 2020, California passed the California Consumer Privacy Act (CCPA) by more than 56% of voters intended to enhance privacy rights and consumer protection for residents of California, United States. However, two years after the first effective day of CCPA, we have observed different patterns in adapting to CCPA in organizations. On the one hand, many organizations quickly upgrade their policy to comply with the legislation and create effective platforms such as data portals that allow consumers to exercise their privacy rights. However, on the other hand, we still notice aspects of CCPA being absent on some websites. Also, we learned that there exists a technique that a social media company may use to minimize the effect of CCPA on their data collecting businesses. Additionally, we found no prior evaluation of the CCPA implementation in organizations. The convergence of the regulatory landscape and the organization's privacy policy needs to be studied. Consequently, this paper is about an empirical evaluation of the implementation of the California Consumer Privacy Act. Included in the report are the evaluations on the following industries: social media, financial institutions, mortgages, healthcare providers, academic institutions. Because of resource constraints, we would choose only the most prominent companies from each category. Our approach is to set up a criteria table constructed from the CCPA Act and then use that table as a checklist while reviewing a company's privacy notice. To evaluate effortlessness in exercising CCPA rights, we set up dummy accounts to generate fiction data, perform data requests such as accessing or deleting, and then observe organizations' responses. Finally, we conclude this paper with an online tool application design that verifies the CCPA implementation. The conjunction of this empirical report and a practical application function as a stimulus to promote CCPA implementation in organizations and inform users about their data rights.

110. **Mathematical Models to Understand Disparate Impact in Machine Learning**

Madison R. Sarmiento, Arman H. Moradi, Trina H. Ngo, Francisco Silva

In this research project, we studied aspects of biases in predictive models. Our long term goal is to think of recidivism - the tendency of a convicted criminal to reoffend - and disparate impact when machine learning is used to predict this. Recidivism is a complicated task to fix, so we built a mathematical model to better understand how to alleviate the issue. We hope to study ways to balance the disparate impact without significantly changing our classifier. In order to model this, we generated a synthetic data set with "color" and "shape" labels as simplifications for recidivism and race. We observed that a logistic regression model predicted the "color" and "shape" labels based on where it was positioned relative to the decision boundary. The goal for the next phase of our research is to study how we can minimize the disparate impact of our logistic regression model.

111. **Misleading Charts**

Alysia G. Wong*, Nana Mimura*, Camryn G. Sumabat, Advisor: Ben Steichen

Many people come across data visualizations without realizing their effects. Misleading charts can lead to inaccurate conclusions. In this research project, we surveyed participants on Amazon Mechanical Turk. With D3.js and COVID-19 data, we created 5 misleading charts and 5 normal charts. We also created 63 associated questions to test comprehension. After surveying 14 participants, we gathered 458 results to identify patterns and analyze the influence of different charts. We have concluded from this data that misleading charts result in a decreased accurate understanding of the data presented. With this information, readers will have a better understanding of the effects of different charts.

112. **Programming Real-Time Retrieval of Statistical Data Using Baseball as a Model**

Mateo Avila, Advisor: Yu Sun

Abstract not provided.

GEOLOGICAL SCIENCES

113. **Microplastic in the Environment: A Review of the Current State of Knowledge**

Kevin C. Diller*, Advisor: Stephen G. Osborn

Microplastics have become increasingly problematic, with potential impacts in the environment receiving more attention in recent years. First discovered in the 1970's, microplastics have continued to invade virtually every environment, from the deep ocean to the atmosphere of the most remote locations on Earth, even the arctic. Considering microplastics are possible sinks for toxic pollutants as well as their persistence within the environment, these plastics are harmful environmental contaminants that continue to be spread as plastic waste increases. Though the pathways and transport of microplastics are not well understood. Generally defined as plastics that are 5mm or less in size, microplastics are often split into two categories: primary and secondary. Primary microplastics are plastics that have been specifically produced to be microplastics, such as abrasives and scrubbers. Secondary microplastics are plastics created through physical, biological, and chemical processes. Currently, there are no standardized

methods of quantifying and identifying types of microplastics. With the lack of a standardized units, microplastic research is difficult to data across multiple papers. Most research conducted has focused on microplastics within the marine environment, as these plastics were first discovered in the ocean. Research investigating contamination in other environments, such as freshwater and terrestrial environments, is lacking but becoming more frequent. Understanding our current knowledge of microplastics is crucial to effectively investigate contamination as well as their effects on our environment. More research on the quantity, sources, and development of a standardized method of measurement and quantification is necessary to determine possible methods of mitigation and to create comparable results. This paper aims to review the current state of knowledge by assessing current research and identifying knowledge gaps.

114. **Geophysical Imaging of the Interior of the Blackhawk Landslide**

Nicholas Madera, Ashley Rivera, Advisor: Jascha Polet

Located in Lucerne Valley, California, the Blackhawk Landslide is considered one of the largest landslides on Earth and is well known for its unsolved mechanism. The agreeing consensus is that the landslide started as a huge rockfall from the Blackhawk Mountain's summit, gained momentum when traveling down through the Blackhawk Canyon, and then launched into the air due to a projecting rib. The mechanism afterwards, remains unsolved. R.L. Shreve's air-layer lubrication hypothesis suggests the landslide behaved as a non-deforming sheet that traveled on a thin layer of compressed air. Alternatives and challenges to Shreve's air-layer hypothesis have been proposed. The purpose of this research is to use DC resistivity and seismic refraction to create subsurface profiles that can used to determine which hypothesis may be correct. Topographic profiles are created via Google Earth Pro to estimate the depth of the underlying alluvial surface relative to the current surrounding alluvial surface. Comparisons between the resistivity, seismic refraction, and topographic profiles suggest that the basal surface of the landslide would have to be 12-15 meters in depth. The velocity model shows a flat interface until at 80 meters away from the seismic source. The resistivity profile shows a rough contact; suggesting that the landslide made contact the underlying surface when traveling down. Some limitations are the relatively small, scaled profile and the need of additional surveys to confirm the wavy pattern and possibly at the end of the resistivity profile. Further studies on the Blackhawk Landslide should focus on studying the contact between the landslide and the underlying surface.

KINESIOLOGY AND HEALTH PROMOTION

115. **May the Force Be with You: Age-associated Index-finger Force Production Variability Using Touchscreen Hand-held Devices**

Charisma E Byrd*, MinHyuk Kwon, Advisor: Lara Killick

Need: Healthcare has adopted the use of hand-held devices (HHD) and smart-technologies to promote the personal health and wellbeing of all persons. While HHDs have become increasingly smart in size and function, much of the research regarding smart-technology fails to include older adults (65+) (Eitivipart et al., 2018). The increased pain and injury associated with smartphone interfaces may impede advances in public health issues and contribute to arthritis or other

functional declines related to aging. To ensure all populations benefit from smartphone devices, the proposed study will examine the relationship between finger-force production and age during mobile device use. Methodology: The study population is healthy young (18-25) and older (65+) adults that are active (30+ minutes per day) HHD users. Through a cross-sectional study design three aims will be tested: Aim 1: Determine the relationship between aging and maximal force production. Aim 2: Compare submaximal force with visual feedback of both groups. Aim 3: Compare muscle activity during maximal and submaximal efforts of the two groups. All aims will be addressed in a single session including a screening questionnaire and familiarization. The subject will perform the maximal and submaximal voluntary contraction task(s) to determine finger-force production and electromyogram for muscle activity during both tasks. The benefits of this study are two-fold 1) improved quality of life for older adults and 2) improved mobile device functionality. Next Steps: I intend to pursue this topic for my thesis and seek feedback from symposium attendees.

116. **Stronger and Balanced: Evaluating the Efficacy of Tai Chi for Older Adults**

Carolina Godinez, Advisor: Lara Killick

Many older adults encounter age related decline in strength and balance, which can lead to a higher risk of falls while in motion. Effective and accessible fall prevention programs for older adults can decrease incidences of falls or fall related injuries. Tai Chi has been known to improve overall physical function, cardiovascular fitness and decrease incidences of falls, especially in older adults. The purpose of this study is to observe the effectiveness of an 8-week Tai Chi program on muscular strength and balance in the older adult population. Recruitment will occur in low SES community wellness centers. A prescreening survey will ensure potential subjects meet the inclusion criteria and will be randomly assigned into two groups. Pre-post intervention strength and balance measurements will be quantified using Timed Up and Go (TUG) test and the Berg Balance Scale; grip strength will also be measured for overall strength. The intervention group will be exposed to Tai Chi while the control group will follow a standard balance training program, with 60-minute sessions, 3 times a week.

117. **Exploring Students' Attitudes Towards People with Disability through Virtual Service-Learning**

Michihito Ichihara, Adviso: Mai Narasaki-Jara

Service-Learning (SL) program in higher education was greatly affected during this COVID pandemic. Students engaged in community services and practiced their skills over zoom. In this study, we explored students' attitudes towards people with disabilities (ATPD) through online SL program. PURPOSE: The purpose of this research was to explore Kinesiology students' ATPD during online SL program. METHODS: A total of two online focus group interview, lasted 60-90minutes, including five students were conducted. Students participated in 8-week SL program providing exercise for individuals with disabilities via zoom. RESULTS: After the thematic analysis, three themes emerged from the focus group interview; a) Difficulty learning through zoom, b) Exposure to the environment and disabilities, and c) Attitude toward people with disabilities. CONCLUSION: The results indicate that online SL program provided knowledge and exposure about disability which improved ATPD but lacked in connection to the community and an

opportunity to practice in-person skills needed for future careers. This finding will contribute to existing SL research in relation to ATPD.

118. Acute Skeletal Muscle Hemodynamic Response to Percussive Massage Treatment

Patric Lee, Advisor: Edward Jo

Percussive massage treatment (PMT) involves mechanical vibration usually applied with a handheld device mechanically similar to a jigsaw. PMT is often implemented as part of a pre-exercise or inter-set routine in efforts to "prime" the muscle for subsequent activity. A warm-up or inter-set rest is in part intended to improve oxygen supply to the muscles involved in the subsequent exercise. However, to our knowledge, the impact of PMT on muscle hemodynamics and oxygenation has yet to be investigated. **PURPOSE:** This exploratory study examined the effects of a single PMT application on lower body muscle hemodynamics and oxygenation as measured by near infrared spectroscopy (NIRS). **METHODS:** Thirty male and female subjects received a 5-minute PMT application on the quadriceps of their dominant leg after 15 minutes of rest. Skeletal muscle oxygen saturation (SmO₂), total hemoglobin (THb), oxy-hemoglobin (Oxy-Hb) and deoxy-hemoglobin (Deoxy-Hb) were measured for 5 minutes prior to and for 10 minutes following the PMT application using NIRS-based muscle oximeters. Concurrent measurements on the contralateral quadriceps were administered serving as the control. Data were analyzed using a two-way ANOVA with significance set at $p < 0.05$. **RESULTS:** There was a significant time x treatment interaction for all dependent variables ($p < 0.0001$). PMT resulted in a significant increase in SmO₂ from baseline at the 4-, 6-, 8-, and 10-minute post-treatment time points ($p < 0.003$). There was no change in SmO₂ from baseline for the control. THb and Oxy-Hb was significantly elevated at all post-treatment points vs. baseline ($p < 0.009$) with PMT with no changes detected for the control. Lastly, Deoxy-Hb was significantly lower than baseline at 4-, 6-, 8-, and 10-minute post-treatment time points with PMT while no change was demonstrated for control ($p < 0.003$). **CONCLUSION:** A single PMT application subsequently improved SmO₂ for up to 10 minutes, accompanied by an increase in THb and Oxy-Hb which was disproportionate to the decrease in Deoxy-Hb. These outcomes may be indicative of increased muscle oxygen availability and consumption which could translate to enhanced performance. However, further investigation is necessary to substantiate these potential effects.

119. The Effects of Percussive Massage Treatment on Focal Hyperalgesia Related to Myofascial Trigger Points

Sarah Pearce, Advisor: Edward Jo

Myofascial trigger points (MTrP) may limit physical function or performance due to altered, pain-averting movement patterns. **PURPOSE:** The purpose of this exploratory study was to investigate the effects of a single percussive massage treatment on pressure pain threshold (PPT), pain perception, and ultrasound-based morphology of active (A-MTrP) or latent (L-MTrP) MTrPs. **METHODS:** Thirty male and female participants (age = 23.9 ± 2.8 years) presenting with at least one MTrP on the upper back (~C6-T7) volunteered for this crossover study. Before and after a single percussive massage treatment around the MTrp and contralateral control site absent of MTrP, pain perception was assessed using a visual analog scale (0-100mm with 0 = "no pain" and 100 =

"intolerable pain") while 50N and 100N of pressure was applied using a digital force algometer. Pre- and post-treatment changes in MTrP morphology and PPT (also using a digital force algometer) were also assessed. A mixed factor analysis of variance was used to assess interaction of time (pre- vs. post-treatment) and treatment site (control vs. MTrP) with significance set at $p < 0.05$. RESULTS: When examining all MTrPs (active or latent) in comparison to control sites, a percussive massage treatment decreased pain perception at 50N and 100N of pressure by 17.2% ($p < 0.001$) and 6.5% ($p = 0.001$), respectively and improved PPT by 17.1% ($p = 0.003$) with no changes in MTrP morphology. The A-MTrPs showed no change in pain perception at 100N of pressure or PPT compared to control sites; however, pain perception at 50N showed a decrease of 12.8% ($p < 0.001$). Those with L-MTrPs showed a significant decrease in pain perception at 50N (-20.6%; $p < 0.001$) and 100N (-10.9%; $p = 0.001$) of pressure and improvement in PPT (21.7%; $p = 0.006$). CONCLUSION: A single percussive massage treatment demonstrated efficacy in producing an immediate, yet likely temporary, focal analgesic effect in those presenting MTrPs, particularly latent or less painful MTrPs. However, these effects were not accompanied by morphological changes in the MTrPs.

120. **Electromyographic Examination of Hip & knee extension hex Bar exercises Varied by Starting Knee and Torso Angles**

Holli Rosas, Advisor: Edward Jo

Variations of the deadlift can be executed using the hexagonal (hex) bar by altering, for instance, the knee and torso angles while maintaining a constant hip angle at the start position. PURPOSE: To examine muscle activation patterns of the biceps femoris, rectus femoris, and erector spinae during three deadlift variations using the hex bar. METHODS: Twenty resistance-trained male and female subjects performed hex bar deadlift variations in three different starting knee flexion positions: $128.4 \pm 8.5^\circ$, $111.9 \pm 8.7^\circ$, and $98.3 \pm 6.5^\circ$. Subjects performed three repetitions at 75% of their three-repetition maximum. Electromyography sensors were placed on the dominant biceps femoris, rectus femoris, and lumbar erector spinae. A one-way repeated measures ANOVA was used to detect differences in mean and peak EMG values normalized to maximum voluntary isometric contraction (MVIC) ($p < 0.05$). RESULTS: As knee flexion increased at the starting position, mean activation of the rectus femoris increased (24.7 ± 21.5 to 35.5 ± 25.4 to $62.1 \pm 31.3\%$ MVIC, $p < 0.001$), while biceps femoris (40.6 ± 17.9 to 34.0 ± 16.4 to $28.1 \pm 14.5\%$ MVIC, $p = 0.003$) and erector spinae (73.0 ± 27.6 to 65.9 ± 34.4 to $54.9 \pm 32.5\%$ MVIC, $p = 0.009$) activation decreased. Peak activation of the rectus femoris increased (46.9 ± 33.0 to 60.9 ± 38.7 to $99.3 \pm 41.6\%$ MVIC, $p < 0.001$) while decreasing in the erector spinae (118.6 ± 47.1 to 105.9 ± 49.4 to $89.1 \pm 40.1\%$ MVIC, $p = 0.008$). The rectus femoris experienced the greatest mean differences of the three muscles.

CONCLUSIONS: Practitioners should consider the muscular goals when adjusting the starting position of a hex bar deadlift as posterior chain recruitment diminished and quadriceps activation increased as knee flexion increased.

121. **Vegan & Gluten-free Pasta Enriched by Legumes with Transglutaminase treatment**

Jacqueline Thach, Advisor: Yao Olive Li

Vegan diets are composed solely of plants with no consumption of animal derivatives. However, due to their lack of intake with animal-derived products, vegans face nutritional deficiencies in their diet that is provided through the consumption of animal-derivatives (e.g., Vit. B12, iron, omega-3-fatty acids, etc.). Individuals on a gluten-free (GF) diet face similar deficiencies since many GF products have to be highly processed to ensure the elimination of gluten from their food. As a consequence, it minimizes their intake of whole grains and they sustain on a diet full of refined starches; lacking consumption of many essential vitamins and minerals as a result. To help aid with the lack of nutritionally sustaining products in the market for vegan and GF individuals, a nutritionally enriched vegan and GF pasta was formulated. It is a legume-based pasta (i.e., edamame, red lentils, & pea protein isolates) that has been treated with transglutaminase (TG) in order to enhance the rheological properties of the pasta. TG is an enzyme that imitates the peptide cross-linking formation of gluten by enzymatically bonding together the R-groups of the amino acids; glutamine and lysine. Since the legumes included in the pasta have the necessary amino acids for TG to work, it is theorized that peptide-bond formation will occur during refrigeration.

122. Take A Chill Pill: "Does an 8-Week Supplementation of Adaptogenic Ashwagandha Reduce Short-Term Anxiety in Young Adults (ages 18-28)?"

Thilini S. Wickramarachchi, Alane Daugherty, Advisor: Lara Killick

Withania somnifera (W.S.), also known as "Indian Ginseng," is an adaptogen. Adaptogens help the body adapt to natural stressors by supporting its ability to adjust to physical, chemical, and/or biological stress. According to the American College Health Association (2021), 14% of college students experience anxiety, negatively impacting academic performance, 9% experience both depression + anxiety, and only 41% of students seek help. This study's purpose is to determine the efficacy of W.S in reducing short-term anxiety amongst college students. Method: Participants (n=60) will be recruited via flyers on campus. The inclusion criteria are people i) aged 18-28 years old, ii) who experience self-reported anxiety, iii) consume fewer than 2 alcoholic beverages/week, iv) are not relocating in the next 8-9 weeks, v) consume less than 200mg of caffeine, and vi) for data purposes, confirm additional supplements and/or medications being consumed. Participants will be randomly allocated to an experimental or control group. The former will be given a single serving size of 1/4 teaspoon of W.S. once a day. The latter will receive no supplementation. The Generalized Anxiety Disorder Survey (GAD-7) will be administered to both groups at weeks 2, 4, 6, and 8. I hypothesize that supplementation with W.S. will reduce short-term anxiety measures. Next steps: I intend to pursue this for my thesis and seek feedback from CAHPERD attendees through this poster.

123. Live Long and Prosper: A Systematic Review of Equipment-Based Training Programs for Older Adults

Landen Wong*, Charisma Byrd, Patric Lee, Katie Lopez, Sarah Pearce, Advisor: Lara Killick

Within the US, people are experiencing longer life expectancy, yet these extended lifespans have not necessarily translated into years living in good health. Degenerative diseases such as osteoporosis and sarcopenia are particularly prevalent amongst older adults. Research shows that

regular resistance exercise carries distinct preventive health benefits to combat these conditions. Therefore, the purpose of this study was to conduct a systematic review into the effectiveness of equipment-based resistance training programs for older adults (65+ years) on physical function. Methods: Five databases were searched (PubMed, Web of Science, Science Direct, Medline, and Sports Medicine & Education Index) in July 2021. Inclusion criteria were participants aged 65 and older, programs that utilized equipment, and intervention studies. Exclusion criteria were non-intervention studies, assessment interventions, animal-based studies, no assessment of physical function, no exercise program, or not published in English. A total of 331 articles were identified, 282 after removing duplicates. Four screeners reviewed the articles independently. Currently, 68 articles are included for the systematic review. Results: Our review will describe the impact of these interventions on static flexibility, walking efficacy, body composition, and other physical factors resulting from a resistance training program in older adult communities. Conclusions: The anticipated outcomes of the review will inform the implementation of equipment-based resistance training programs with older adults.

PHYSICS AND ASTRONOMY

124. **Searching for High Mass X-ray Binaries in Nearby Galaxies**

Hezron Acosta*, Jacob Payne, Advisor: Breanna Binder

We have searched for X-ray binaries (XRBs) in nearby galaxies using the Hubble Space Telescope (HST) and Chandra X-ray Observatory (Chandra). We visually identify 295 XRB candidates in 14 different nearby star-forming galaxies. We created color magnitude diagrams for each galaxy to determine which XRB contain high mass stars. The observable properties of high mass XRBs (HMXBs), such as X-ray luminosity, are known to correlate with the properties of their parent galaxies (such as metallicity and star formation rate). In this project, we present a color magnitude diagram of Holmberg 1 field 1 along with a high mass region in the color magnitude diagram. We also present color images of possible X-ray binary candidates and non-X-ray binary candidates.

125. **Gaia and Chandra Detangle Multiple Young Stellar Populations in the Direction of NGC 6357**

Aldair Bonilla, Carly Soos, Advisor: Matthew Povich

We present a sample of ~ 800 young stellar objects (YSOs) in the field of the NGC 6357 massive star-forming complex detected with the Chandra X-ray Observatory observations and appearing in Gaia EDR3. We also cross-matched our list with near- and mid-IR Galactic plane survey catalogs produced by VVV/2MASS, and GLIMPSE. The unprecedented astrometric precision of Gaia EDR3 (0.4 mas/yr) reveals 70% of these stars are grouped into three proper motion clusters identified visually and confirmed using DBScan. The largest proper motion cluster contains 722 sources including Pismis 24 and the two more obscured massive stellar clusters in NGC 6357. Two distinct, smaller proper motion clusters (56 sources) differ from the main cluster by $RA \sim 2$ mas/yr and $Dec \sim 0.1$ mas/yr. The parallax distribution of the main cluster peaks at ~ 0.5 mas while the two smaller proper motion clusters peak at ~ 1 mas. One of the smaller proper motion clusters is scattered

spatially across the field, while the other is concentrated in the northwestern region of NGC 6357. We combine our sample with a larger set of YSOs from the SPICY catalog, including those without X-ray detection, for a combined membership list of ~ 1000 YSOs in NGC 6357.

126. Investigation of Structural Details and Dynamics of the SecA Protein in Native Conditions via Atomic Force Microscopy

Leona Choi, Matthew P. Luna, Advisor: Krishna P. Sigdel

Membrane proteins are responsible for various important cellular processes such as protein export, signal transduction, enzymatic activities, and cell-to-cell communication. Membrane proteins also constitute more than half of all current drug targets. SecA is a member of the membrane protein family with the primary function of transporting nascent proteins through the inner membrane and into the periplasmic region of *E. coli*. Studies suggest dynamic interactions between the SecA protein and the lipid bilayer during this translocation process. Since structural details and conformational dynamics are tied to functions, we performed high-resolution imaging of SecA interacting with a lipid bilayer in physiological buffer conditions via atomic force microscopy (AFM).

127. Investigating the Effects Major Mergers have on Dwarf Galaxies through FIRE simulations

Jeysen Flores-Velázquez, Advisor: Coral Wheeler

Dwarf galaxies are low mass ($M_* < 10^6 M_\odot$) galaxies that are dominated by dark matter. Dark matter is thought to be a form of invisible matter distributed in galaxies. It is not known what the nature of dark matter might be, but we can study it through its effects on dwarf galaxy kinematics. Therefore, studying dwarf galaxies will help us understand the nature of dark matter. The merging process is a transformative process that can have serious implications on galaxy kinematics and galaxy formation theory. Major mergers (1:10 mass ratio) in dwarf galaxies are rare events that drastically alter the kinematics of a galaxy and so have implications on the study of dark matter and galaxy formation processes. We investigate the effects of the merging process on dwarf galaxies through high resolution cosmological zoom-in FIRE/Gizmo simulations. With this tool we simulate a dwarf galaxy major merger to study the changes in the rotational support, age and metallicity gradients, star formation, and stellar kinematics before, during, and after the major merger. We find interesting tracers of major mergers in dwarf galaxy properties including an uptake in star formation, and a decrease in rotational support during the major merger.

128. Continuum percolation of circles with correlated positions

Diego Esteban Garcia, Andrew John Froning, Advisor: Alex Small

Percolation is among the simplest known phase transitions, being understandable entirely in terms of geometry: One randomly deposits objects (e.g. sticks, circles, bonds on a lattice) and checks whether there is a cluster of overlapping objects that span the system from one side to the other. At a critical density of objects (ratio of objects to area or volume), the probability of a spanning cluster spikes from nearly zero to nearly one. This concept has found applications in the study of porous materials, gels, alloys, and even disease transmission. We are studying a 2-

component percolation problem, where circular discs are constrained to sit on a system of fibers (i.e. straight lines, like sticks). The sticks are typically at or near the critical density for stick percolation, and we use computer simulations to determine when the circles percolate. The critical density of circles depends sensitively on the ratio of circle diameter to fiber length. Interestingly, the critical density peaks at an intermediate ratio of fiber length to circle diameter, and then decreases. We try to understand this peak behavior by examining the geometry of circles on small collections of fibers, and determining the likelihood of a circle on one fiber touching a circle on another fiber.

129. **Simulating Dark Fossils of the Early Universe**

Nicholas-Tyler Howard, Advisor: Coral Wheeler

According to the Λ CDM model of the universe, there should be a halo of dark matter (a hypothetical form of matter that only interacts gravitationally on normal matter) surrounding and containing every galaxy. The model has faced challenges in recent years due to observations of low mass galaxies ($M_{\text{galaxy}} < 10^6 M_{\odot}$), which have found significantly fewer satellite galaxies than naively predicted by assigning galaxies to dark matter only simulations of the Λ CDM model. Reionization in the early Universe - when the first stars and other luminous sources ionized the gases in the universe - has likely played a role in this observed lack of satellites, as ionizing the gas would disrupt the cold and dense environment required for stellar formation. We simulate the effects of different timing and sources of reionization on dwarf galaxies using high resolution cosmological zoom-in simulations of dwarf galaxies ($m_{\text{gas}} = 250 M_{\text{sun}}$) run the FIRE-(Feedback In Realistic Environments) code. FIRE is a powerful tool for simulating dwarf galaxies because it uses a realistic stellar feedback all based on first principles. We simulate three different reionization backgrounds with the FIRE code, 'Double' in which we double the photo-heating and photo-ionization rate, 'Late' in which reionization occurs later than in our fiducial runs, and 'Normal' where all parameters are as predicted. We investigate the star formation histories and stellar mass to halo mass relationship of the three reionization backgrounds to make testable predictions for their effect on the counts and properties of dwarf galaxies. In this way, we can place constraints on the sources and local timing of reionization.

130. **Spectral Analysis of an Atmospheric Pressure Low-Temperature Helium Plasma Instruments**

Madison Keene, Quinn Gilbert, Advisor: Nina Abramzon

A nonthermal ("cold") atmospheric plasma jet can be generated in flowing gas by applying an AC electric field. We generate such a jet using a high voltage (up to 30 kV) kHz power supply connected to electrodes encircling plastic tube flowing helium. Cold plasma produced by plasma jets consists of reactive oxygen species that can be identified through spectroscopy, and applied in many applications of the medical field and for surface treatments. Commercial cold plasma reactors are expensive. Our experimental set up produces a cold atmospheric helium comparable to that from commercial devices, but at a fraction of the cost. Using spectroscopy, we have found that there is a significant amount of reactive oxygen species produced by our plasma jet, notably we observe atomic oxygen peaks at 390 nm, 615 nm, and 777 nm wavelengths, as well as an OH

peak at 308 nm. Our plasma jet is a potential cost effective alternative to commercial reactors for producing such species.

131. **Plasmonic resonance in hyperbolic metamaterials with prism and grating couplings**

Liam N Mauck, Miguel A Maldonado, Advisor: Ertan Salik

Hyperbolic metamaterials (HMM) constitute a class of artificial materials that allow for higher frequency plasmonic modes, which in turn can be developed into optical sensors with higher sensitivity than surface plasmon sensors. We simulated HMM structures using the wave optics module of COMSOL Multiphysics, a finite element method-based numerical simulation package. Plasmonic sensors work based on light coupling to plasmonic modes, and they require either a prism made of a high refractive index material, such as silicon or a grating to achieve coupling. We studied a 3-layer (gold-silica) HMM structure. We found that in the case of prism coupling surface plasmon modes (SPP) were sensitive to refractive index change of surface materials while bulk plasmon modes (BPP) were not. In the case of grating coupling, BPP modes were found to be much more sensitive to changes in the refractive index of the adjacent medium.

132. **Stability of Fe-U compounds and of Fe-bcc with U substitutions at the pressures of the Earth's Core**

Cameron Michael Moffett-Smith, Advisor: Jorge Botana Alcalde

The composition of Earth's core is not fully understood. Specifically, it is unanswered whether or not Iron compounds are stable at various pressures. In our project, we are investigating the stability of Iron compounds of differing geometries with Uranium impurities at a range of pressures found in the Earth's core. Specifically, we are applying software, VASP, to perform relaxation calculations in which the geometries are slightly changed and the total enthalpy of the system is calculated using density functional theory. The focus will be between the mantle-core boundary (MCB) pressure, approx. 250 Gpa, and the inner core boundary (ICB) pressure, approx. 350 GPa. We will learn more about the relative abundance of compounds in the Earth's core.

133. **The SPICY Milky Way: Evaluating the Reliability of an Inner Galactic Plane YSO Catalog**

Carly M Soos*, Aldair Bonilla, Advisor: Matthew Povich

Young stellar objects (YSOs) are stars in the early stages of their evolution that frequently exhibit infrared-excess emission from dusty, protoplanetary disks. The Spitzer IRAC Candidate YSO (SPICY) Catalog is the most comprehensive list of YSOs in the Galactic midplane compiled to date, containing ~120,000 objects identified from GLIMPSE source lists. We selected a combined 876 candidate YSOs in the SPICY Catalog in two massive star-forming regions within 10° (projected) of the Galactic center, NGC 6334 and NGC 6357, to evaluate contamination rates in one of the most crowded sightlines of the Galactic midplane. We supplement SPICY with Chandra/ACIS X-ray-identified YSOs, which expands the area of mid-IR color space to include stars with weaker IR excess. The most likely contaminating sources would be highly-reddened background giants. We find that the H - KS versus KS - [4.5] color-color diagram is the most useful to evaluate SPICY contamination. The sources separate into two loci: a larger, lower locus containing YSOs showing

intrinsic infrared excess and an upper locus strongly affected by foreground reddening that hosts a mix of X-ray YSOs and likely contaminating sources. The upper locus reveals a higher ratio of sources with $E(H - KS) > 1.5$ compared to the lower locus, representing an estimated 3% contamination rate in the SPICY Catalog for these regions. We also examine areas of the mid-plane without massive star-forming regions, where the YSOs are more widely distributed on the sky, and contamination rates are expected to be higher. Finally, we construct a comprehensive membership list of $\sim 1,600$ sources for NGC 6334, including both SPICY and Chandra/Gaia-identified young stars and YSOs.

134. **The Milky Way Project: MOBStIRS (Mass-Loss Rates of OB Stars Driving IR Bow Shocks)**

Angelica S. Whisnant, Henry A. Kobulnicky, Advisor: Matthew Povich

Infrared stellar wind bow shock nebulae are generated by the relative supersonic velocity between powerful stellar winds from massive stars (typically O- or early B-type stars) and the surrounding interstellar medium. Significant amounts of mass are lost through these stellar winds (10^{-7} to 10^{-4} solar masses per year); however, theoretical values for mass-loss rates can differ by an order of magnitude from those derived from various observational techniques. This project aims to measure size and shape parameters among the ~ 1000 known infrared bow shocks using the online Zooniverse platform, which enables "citizen scientists" to participate in research. The citizen scientists in this project (high school and college students taking general astronomy courses) will make drawings on bow shock images taken by the Spitzer Space Telescope. Each image will be measured by at least 20 different users. Reliability and uncertainty of the measurements of each image will be determined by analyzing the dispersion among different users' measurements. Compared to subjective measurements made by a few "expert" scientists, this system of data analysis allows for more unbiased results. The final values will help determine the true sizes and shapes of bow shocks and their inclination angles, which are necessary for deriving accurate mass-loss rates in the stellar winds of the driving stars.

135. **Studying the Variability of IC 10 X-2, a High-Mass X-ray Binary Containing a Possible Luminous Blue Variable and Neutron Star**

Mina Thoresen, Advisor: Breanna Binder

An X-ray binary (XRB) is a binary star system consisting of a neutron star (NS) or black hole (BH) and a donor star. The NS or BH accretes matter from its donor star, which then emits X-ray radiation. XRBs fall into two general categories: high-mass X-ray binaries (HMXBs) and low-mass X-ray binaries (LMXBs) based on the mass of the donor star. IC 10 X-2 is an XRB that likely contains a NS and an LBV. It is also a supergiant fast X-ray transient (SFXT), which is an HMXB that exhibits fast and large X-ray outbursts. These outbursts could be triggered by material ejected from the LBV donor during an eruption falling onto the NS. Both SFXTs and LBVs are extremely rare, making IC 10 X-2 a unique object that will allow us to study the physics of LBV eruptions and mass transfer onto a NS.