Ronald E. McNair Achievement Program

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Daniel Acosta

University of Arizona, Microbiology

Mentor: Dr. Istvan Molnar – School of Natural Resources and the Environment

A Chloroperoxidase may be Responsible for the Chlorination of Dehydrocurvularin in *Alternaria sp.* AST0039

ASTRACT: 4,6-dichloro-10(11)-dehydrocurvularin (Cl2DHC) is a natural product derivative of 10(11)-dehydrocurvularin (DHC). Produced by the fungus Alternaria sp. AST 0039, Cl2DHC is a promising oncology drug due to its ability to specifically inhibit ATPase p97 in human cancer cell lines. This bioactivity is the result of the chlorine in Cl2DHC, however it is unknown how chlorine is added to the molecule. A study was conducted at the University of Arizona to determine the potential role of a putative chloroperoxidase in chlorinating DHC to produce Cl2DHC in the fungus Alternaria sp. AST 0039. Using yeast optimized synthetic DNA, the yeast Saccharomyces cerevisiae BJ5464 was engineered to produce all of the enzymes known to participate in the synthesis of DHC together with the putative chloroperoxidase. In pilot experiments the engineered yeast was unable to produce Cl2DHC. While the engineered yeast was unable to produce Cl2DHC, the yeast was able to produce DHC. Currently experiments are being run to assess the level of success in engineering S. cerevisiae BJ5464. Future experiments will repeat the study methodology as well as test alternative methods of enzymatic chlorination using the putative chloroperoxidase. Moving forward, further experiments are required to clarify the role of the chloroperoxidase in the formation of Cl2DHC.

Maria Acuna Baltierra

University of Arizona, Political Science and Spanish

Mentor: Dr. Jessica Maves Braithwaite – School of Government and Public Policy

Rebel Group Splintering and Strengths of Central Command Structures

ASTRACT: In the context of civil wars, we often see multiple rebel groups fighting against the same government, and in a number of these cases one or more of those organizations split away from a previously-active rebel group—this is called "splintering." Splintering can be important for a number of conflict dynamics including the fighting capacity of rebel groups relative to the government, the credibility of rebel groups as bargaining partners, and the durability of rebel groups in the long run. However, we know very little about when and why rebel group splintering occurs. Existing explanations for splintering focus on disagreements over whether rebel groups should negotiate with the government, the perpetration of abuse against noncombatants, battlefield performance, personal disputes between leaders within rebel groups, and the influx of external support. One factor that likely unites/impacts rebel groups is the ability to overcome principal-agent problems and maintain cohesion. Principal-agent problems can be alleviated by having a strong central command structure within the organization that can identify and punish behavior that deviates from what is intended for the good of the group. Thus, we argue that rebel group splintering should be less likely when groups have stronger central command structures. We use original data on when rebel groups experience splintering in civil wars around the world occurring between 1946-2011. Our findings support our theory that rebel groups with better-developed leadership and control structures are less likely to experience splintering as compared to groups with low or no centralized command structures

Makyla Allison

University of Arizona, Veterinary Science, Family Studies and Human Development

Mentor: Dr. Dieter Steklis and Dr. Netzin Steklis – Animal and Comparative Biomedical Sciences

Building Empathy Through Agriculture-Based Humane Education

ASTRACT: Humane Education Programs (HEP) are placed within the long-standing field of character education that primarily focuses on promoting kindness, compassion, and concern for animals, people, and the environment (Samuels, Meers, & Normando, 2016). HEP uses animal-related stories, lessons, and activities to encourage empathic behavior in children's relationships with living beings (Faver, 2010). HEP posits that building empathy through the use of animals positively influenced a person's emotional response and attitudes towards living things generally. Studies have shown the effectiveness of building compassion in children and adults using companion animals. However, few studies provide evidence of using agriculture-based animals, exploring the use of friendly pet animals in influencing humane behavior and positive attitudes (Hawkins et.al., 2017), ignoring how aspects of agricultural animal husbandry may influence the development of compassion. In investigating HEPs influence on teaching empathy, there is a gap in understanding the influence of using different kinds of animals in examining the potential subsequent differences in how a person may react to a living being when placed in harmful situations. The claim of HEP that development of empathy for animals will result in caring and concern toward other living things (Komorosky & O'Neal, 2015) is underexamined as current studies focus on promoting empathy through traditional animals (Kolof et.al., 2016), but do not investigate if subsequent empathy levels toward animals AND humans are similar when presented in comparable situations. Our study on agriculture-based HEP examines the effects of using livestock animals on teaching empathy as well as the differential influence on animal-related and human-related empathy.

Robert “Tre” Ballance

University of Arizona, Microbiology

Mentor: Dr. Antonio Estrada – Mexican American Studies

The Health Disparities of Obesity and Diabetes within the US Multiracial Population

ASTRACT: With a rapidly growing population in the United States of America, research focused on the health of those who identify as two or more races is becoming increasingly important. This study will examine previously published literature focused on different health disparities within the multiracial US population. Following the literature review, the closely related health disparities of obesity and diabetes will be the focus of the remainder of the paper. The method of finding articles to use involved utilizing electronic databases including PubMed and Google Scholar. Through the databases, the key words of “multiracial, obesity, and diabetes” were searched. The criteria of inclusion include having data with ‘multiracial’ as an option. The studies for each disparity are compared with each other to determine whether they have similar results, how the data was obtained, location of the study, and possible limitations. Additionally, data from the National Health Interview Survey is used to determine if the results from the more localized articles are like the national data. The results found indicate that the multiracial population does have higher rates of obesity and diabetes. A discussion focused on the impact of the social determinants of health and a multiracial person’s culture is explored. Approaches to intervention to help eliminate the disparities are also explored. Implications of the study include the need for more research focusing on the multiracial population in general, as well as a deeper understanding of the relationship between a multiracial identity and health when attempting to help people within the population.

Savannah Brown

University of Arizona, Biosystems Engineering

Mentor: Dr. Kaveh Laksari – Biomedical Engineering

Neurological, Cognitive, and Postural Effects of Soccer Headers

ASTRACT: According to the University of Connecticut, 1.6-3.8 million traumatic brain injuries (TBIs) are reported due to sports in the United States. Although protective technologies have been developed to prevent TBI related deaths, mild traumatic brain injuries such as concussions are still rising. Soccer, a very popular sport, allows players to use their head to redirect an oncoming soccer ball, known as a soccer header. However, there is concern regarding the effects of repetitive soccer headers on brain function. The purpose of this study is to determine the neurological, cognitive, and postural effects of soccer headers and whether they are different from head motions without any external object impacting the head. To evaluate the effects of each condition, each participant was administered a series of neurological and balance tests before and after the loading conditions were applied. The contact loading group of participants headed a soccer ball consecutively to simulate how many balls a soccer player would normally head during practice. In the non-contact group, the soccer header motion was simulated using a pulley system attached with a headband to the participants head. The recorded head and neck kinematic results between the two groups would then be compared by using sensors and a multi-camera system. It is hypothesized that the contact group would have a worse score on the neurological and balance tests indicating that there was some acute change in brain function after impact from the soccer ball which is greater than that of no contact head motion.

Michael Cardenas

University of Arizona, Physiology and Neuroscience

Mentor: Dr. Andrew Fuglevand - Physiology

Autonomic signals inform the subjective perception of social touch

ASTRACT: Grooming is a prosocial behavior used by rhesus macaques (Macaca mulatta) to establish social bonds and build alliances. Monkeys also exchange social favors, maintain hygiene, and construct a social hierarchy by grooming. Grooming also induces a reduction in heart rate and is linked to an increase in vagal tone. Little is known about neural circuitry of affiliative behaviors when compared to our current knowledge on the neural mechanisms underlying agonistic behaviors. Our goal is to determine how the brain processes social touch in rhesus monkeys as a proxy for other prosocial behaviors in primates, including humans. We designed an experiment that evaluates neural activity in two brain areas associated with touch; the primary somatosensory cortex (SI) which discriminates tactile features of touch, and the amygdala which extracts with the emotional aspect of the touch. We hypothesize that SI will respond equally to both air puffs and human touch, but the amygdala will respond differently to each type of touch. Preliminary data from ongoing experiments indicates that a large population of amygdala neurons that respond to non-social touch do not respond to social touch delivered to the same area. We theorize that differentiated processing of social and non-social touch may modify the autonomic state of the receiver.

Aileen Clara

University of Arizona, Biology

Mentor: Dr. Daniela Zarnescu – Molecular and Cellular Biology

Drug Screening for ALS Using Drosophila Models

ASTRACT: Amyotrophic lateral sclerosis (ALS) is an escalating and deadly neurodegenerative disease that impacts both upper and lower motor neurons in the brain and spinal cord. Paralysis and eventually death occur typically within a 2-5-year span after diagnosis. However, treatments for ALS are scarce and mostly palliative for patients. Recent studies have shown that a neuropathology is found in ALS, which is labeled by the TAR-DNA binding protein (TDP)-43. In this study, we are using a Drosophila model of ALS based on TDP-43 to compare the effects of Riluzole and Radicava, which currently represent the standard of care for ALS. We are measuring the effect of currently FDA approved drugs in an effort to compare the effectiveness of new drugs we are developing in the laboratory. Previous studies from the lab shadowed that expression of wild-type TDP-43 (TDP WT) or disease associated, mutant TDP-43 causes similarities with the human disease including locomotor dysfunction, reduced lifespan and pathological aggregates. Following the crossing of D42GAL4 females with males harboring TDP-43 transgenes or w1118 controls, the flies are switched to food mixed with drugs of interest, then the larvae are collected and evaluated for locomotor function using larval turning assays. The larvae are flipped and timed to see the time it takes to right themselves backup. We have found that there is some rescue in locomotor function however these drugs do not cure the disease nor reduce life expectancy in humans. In summary, we expect to improve therapies for ALS patients and find better treatments.

Anna Marie Cosgrove

University of Arizona, Nutritional Sciences

Mentor: Dr. Richard Simpson – Nutritional Sciences

Comparative Analysis of Lymphocyte in Individuals after Exercise and Isoproterenol Infusion

ASTRACT: Immune therapy is a main stray of treatment for cancer patients. Research shows that beneficial lymphocytes such as natural killer (NK) cells, γδ T-cells are mobilized after exercise which can improve graft composition (Simpson et al., 2017). However, some donors may not be able to exercise for long periods of time due to low fitness levels. Isoproterenol (ISO), a β2-adrenergic receptor agonist infusion also increases lymphocyte counts in peripheral blood. In this study, we compared lymphocyte mobilization from healthy donors after exercise with mobilization after infusion of ISO. A total of 5 healthy volunteers underwent 30 minutes of ergometer bike riding (15% above ventilatory threshold), and infused with isoproterenol (50 ng/kg/min) for 30 minutes on two separate occasions. Blood samples were collected before and at the end stage of exercise and ISO infusion, and analyzed using flow cytometry. We hypothesized the number of lymphocytes, such as natural killer (NK) cells and γδ T-cells, to increase after these interventions. This is a comparative analysis of lymphocytes mobilized with exercise and ISO infusion. In summary, we predict that these interventions will be able to reduce Graft-Versus-Host-Disease and ultimately improve treatments of transfer immunotherapy.

Kareen Alexandra Fajardo Cortes

University of Arizona, Biomedical Engineering

Mentor: Dr. Minkyu Kim – Biomedical Engineering

Hierarchical Network Formation for the Fabrication of Strong and Homogeneous Artificial Protein Hydrogels

ASTRACT: Artificial protein hydrogels improve upon traditional biomaterials by incorporating functional proteins into the polymer networks. However, topological defects, a grand challenge facing the field of polymer science, limit the ability to translate the nanoscale functionality of proteins in macroscale materials. In prior research, triblock polymers design that incorporate rod-like tertiary-structured proteins in the midblock domain reduces topological defects by improving crosslinking efficiency and gelation kinetics. Triblock polymers, comprised of the midblock surrounded by crosslinking proteins, can associate through physical or chemical bonds. Physically crosslinked hydrogels, with electrostatic, Van Der Waals, and/or hydrogen bonds, are self-healing and homogeneous, but are relatively weak. Chemically crosslinked hydrogels form strong and permanent covalent bonds but often form inhomogeneous networks due to quick and irreversible binding kinetics. This study implements hierarchical network formation to overcome the limitations of chemical and physical crosslinkers using three main components: streptavidin, a self-associating protein with high affinity and strong physical interactions; tyrosine, an amino acid photo-crosslinker that promotes homogeneity via stimuli-induced crosslinking; and a rod-like midblock to improve crosslinking efficiency and gelation kinetics. The viscoelastic mechanical properties of the fabricated artificial protein hydrogel will be analyzed by shear rheology measurements to evaluate its potential for future biomedical applications in cardiovascular tissue engineering.

Lara Guevara

University of Arizona, Speech, Language, and Hearing Sciences

Mentor: Dr. Leah Fabiano-Smith – Speech, Language, and Hearing Sciences

Speech Sound Productions of Spanish-English Bilingual Children

ASTRACT: This study applied two theoretical frameworks of bilingual speech in order to examine the phonological patterns of English gliding and Spanish substitutions in the speech productions of Spanish-English bilingual children. In both English gliding and Spanish substitution patterns, children replace complex sounds, such as rhotic sounds ('r' sounds) or the 'l' sound, with less complex sounds. Spanish-monolingual and English-monolingual children demonstrate distinct substitution patterns for rhotic sounds and the 'l' sound. The purpose of this study was to compare the percentage of gliding across English monolingual children and Spanish-English bilingual children. The study also aimed to determine whether bilingual children cross-linguistically transferred English and Spanish phonological patterns. Data was obtained from a larger study funded by the National Institute of Health (NIH) and led by The Bilingual Phonology Lab at The University of Arizona. Ten English monolingual and ten Spanish-English bilingual children aged three to six were included in the study. Speech samples elicited through a picture-naming task were audio-recorded and phonetically transcribed. Statistical and qualitative analyses of English gliding and Spanish substitutions were conducted. A statistical analysis showed no significant difference for the percentage of gliding in the English productions of monolinguals and bilinguals. In the bilingual group, a qualitative analysis revealed more cross-linguistic transfers of English patterns to Spanish productions. Preliminary results support the theoretical framework of general transfer between language systems, as proposed by Paradis and Genesee (1996). Additional studies with larger sample sizes are needed to further investigate phonological patterns in the speech of bilingual children.

Onieda Hudson

University of Arizona, Nutritional Sciences with an emphasis in Dietetics

Mentor: Dr. Floyd Chilton, Nutritional Sciences

Systemic Inflammatory and Metabolic Response of Humans to Lipopolysaccharide Stimulation

ASTRACT: The molecular network(s) that provide the underpinning of a systemic inflammatory response in humans is not well understood. To address this issue, we obtained plasma samples from the control group of the Omega-3 Fatty Acid Concentrate in a Placebo-Controlled Trail of Human Endotoxemia Study conducted at Pennsylvania State University. Human males were injected with lipopolysaccharide (LPS), and early and late phase inflammatory and metabolic responses were monitored. These individuals showed early and late phase inflammatory responses as measured by inflammatory cytokines (TNF-alpha and IL-6) and C-Reactive Protein, respectively. The metabolic response to LPS was determined by carrying out metabolomic analysis of plasma samples throughout the time course of the study. Inflammatory cytokines increased dramatically between 2 and 4 hours, and CRP at 24 hours after LPS injection. Metabolic profiles revealed a number of phospholipase-dependent products from phosphatidylcholine were generated after LPS challenge. Specifically, there were large increases in 1-acyl-2-lyso-GPC, glycerophosphorylcholine and choline suggesting phospholipase A2, phospholipase A1, and phospholipase D activities were activated. Importantly, products of these reactions continued to increase throughout the 72-hour time course examined. These data suggest that phospholipase-dependent lipid mediators may play a critical role in systemic inflammation and its resolution.

Malik Jordan

University of Arizona, Mechanical Engineering

Mentor: Dr. Cho Lik Chan – Aerospace and Mechanical Engineering

Effect of Badminton Racket Properties on Momentum Transfer to a Shuttlecock

ASTRACT: Mathematical modeling was used to analyze the effects of racket design on the transfer of momentum between a badminton racket and a shuttlecock. String tension and racket flexibility were the parameters examined in the model. The aim of this study was to determine the tension and flexibility that maximizes the rebound velocity of a shuttlecock. A wide range of values were considered in order to find a trend in the model data. One model was created to measure the lone effect of racket flexibility and another was created to measure the combined effect of string tension and racket flexibility. The racket frame and string bed were each modeled as a spring and damper in parallel to account for the dampened vibrations in the both locations following impact. To better understand the effects of various tensions and flexibilities, the swinging motion of the racket held constant for each calculation. From these data it will be possible to design a racket that is suitable for generating optimal power in a stroke.

Trevor Lohr

University of Arizona, Physiology and Anatomy

Mentor: Dr. Klearchos K. Papas and Dr. Leah Steyn – Surgery

The Effects of Various Oxygen Conditions on Rat-2 Cells

ASTRACT: Encapsulation using an immunoisolation device offers a promising treatment option for transplantation of islets and cells into diabetic patients. These devices enable the use of allogeneic and ultimately xenogeneic islets or cells with minimal or no immunosuppression. The treatment of diabetes requires a large number of islets, which creates high densities of cells in small, reasonably sized devices. Oxygenation of the cells or islets within these devices becomes crucial in order to preserve function and viability post-transplant. If hyperoxia or hypoxia occurs before the cells are transplanted, or while the implanted islets are in the process of reaching adequate vascularization, there may be increased cell stress and death. Various cell lines have been tested and have shown promise in reversing the effects of type one diabetes. In this study, methodology was developed to test the effects of varying oxygen concentrations on any given cell line. Rat2 cells were the first cell line used to establish this methodology, and through this, the effects of oxygen variance on Rat2 cells were recorded and analyzed.

Diana Madril

University of Arizona, Information Science and eSociety

Mentor: Dr. Catherine Brooks and Dr. Sara Young –
School of Information

Cuban Adaptation of Internet Access and the Tech Hive

ASTRACT: This paper evaluates the Cuban culture of adaptation in accessing the Internet through creative methods. The island of Cuba has been under the power of Castro and his regime since 1959 and has continued through creating tech elites as a vision of the second revolution. Cuba has been under a locked embargo implemented in 1962 through the Kennedy administration, and through the embargo the technological infrastructure had faltered, and has been slow to progress. Castro had plans for the island to be the elite in the tech industry by implementing schools to create students proficient in coding and computer skills. The University of Information Science (Universidad de las Ciencias Informaticas, UCI) established in 2002, had the intention of creating a system of tech elites for the island. Although the internet infrastructure is slow in developing a stable internet access for the island, and resources are limited, Cubans have adapted. A diverse array of various backgrounds of high school students throughout the island are being trained in coding skills. Through connectivity disparities the island adapted new measures of obtaining digital content through illegal means called the “El Paquete” as it remains the outlet of shows, news, entertainment and much more. Although Cuba now depends on Wi-Fi hotspots to connect online while some hotels on the island host as well, much of the political terrain of Cuba remains controlling content through radio and TV. Political tension remains and the Cuban government stands firm through censorship, many internet markets have shown innovative entrepreneurial businesses arising.

Kayley Manuel

University of Arizona, Microbiology

Mentor: Dr. Gayatri Vedantam – School of Animal and Comparative Biomedical Sciences

2019 *Clostridium difficile* Surveillance in Tucson, Arizona and Comparison to 2018 Data

ASTRACT: Clostridium difficile infection (CDI) is one of the most prevalent and costly healthcare-associated infections. The causative agent, C. difficile, is the leading cause of antibiotic-associated diarrhea. CDI surveillance is used to characterize the diversity and epidemiology of virulent strains and our laboratory performs human CDI surveillance in the Banner University Medical Center (BUMC) in Tucson, Arizona. My project focuses on interpreting CDI surveillance findings and ultimately deriving future research hypotheses. We are using a sensitive DNA fingerprinting method called PCR ribotyping to characterize C. difficile clinical strains and ribotypes from all collected 2019 specimens. Pathogen diversity and respective GDH and EIA test results will be evaluated against 2018 data and portions of national data. This study will determine if BUMC clinical C. difficile diversity has fluctuated over time.

Francisco Martinez

University of Arizona, Chemical Engineering

Mentor: Dr. Roberto Guzman – Chemical and Environmental Engineering

Encapsulation of Dasatinib in Polymer Nanoparticles for Controlled Release Cancer Therapy

ASTRACT: Nanoparticle research on drug delivery systems focuses on improving the properties of pharmaceuticals by encapsulating them. The tyrosine kinase inhibitor Dasatinib is used to treat chronic myeloid leukemia (CML). However, Dasatinib like the majority of cancer drugs suffers from poor bioavailability, high toxicity, and the development of resistances through cell mutations. Encapsulating Dasatinib in poly(DL-lactic-co-glycolide) acid (PLGA) may improve CML treatment by counteracting the negative properties. The encapsulation was performed through nanoprecipitation in a modified technique of that of Fessi et al. (1989). It involved the use of an organic phase and an aqueous phase. Centrifugation and a lyophilizer were used to separate the nanoparticles. The nanoparticles were then analyzed using a Zetasizer to get the zeta potential, diameter size, and polydispersity index of the particles. A calibration curve was also performed in order to relate the absorbance of Dasatinib to the concentration. A drug release study was also performed through dialysis by using a membrane. The drug release figures depict the rapid initial release within the first 20 minutes. Then for 20-150 minutes, there was a gradual declining slope until it seemed to reach zero. It is still necessary to measure the amount of drug loading along with calculating the encapsulation efficiency of the nanoparticles.

Nyssa Morgan

University of Arizona, Molecular and Cellular Biology

Mentor: Dr. Frans Tax – Molecular and Cellular Biology

KIN7 Interacts with CEPR1 to Form Filaments in Plant Cells

ASTRACT: Recent research on the mechanisms of plant signaling has identified transcription factors and receptor proteins crucial for plant responses, but little is known about the molecular interactions between these molecules, and the varying physiological changes that can result from their interplay. When a plant experiences some environmental stress or nutrient, they recognize this change in the atmosphere and carry a signal to an internal receptor. This receptor, in collaboration with other molecules, can respond to growth factors, growth inhibition factors, and can even cause the plants to form cellular filament structures with no understood function at all. The goal of this study is to understand the reaction between molecules that organize these mystery filaments inside of plant cells. One example of molecular partners that play a role in this are the KIN7 and CEPR1 receptor kinases. KIN7 is known to be expressed in leaf tissues, but recent studies have revealed its interaction with CEPR1, a key protein in nitrogen responsive lateral root development. Understanding the molecular interaction between the two kinases could unveil the function of these oligomers and provide details of how plants respond to their environment. To address this study, we used plant DNA extraction techniques and conducted PCR and gel electrophoresis tests to confirm the purity of our samples. Then we used recombination methods to amplify our desired gene and transform it into Arabidopsis for phenotypic observation. We expect our results to reveal how KIN7 and CEPR1 interact on a molecular level and to confirm that KIN7 and CEPR interact to form these and filaments in the cell.

Victoria Nguyen

University of Arizona, Public Health

Mentor: Dr. Kelly Reynolds and Dr. Johnathon Sexton –
College of Public Health

Efficacy of SpectraShield Powder Against Microbes

ASTRACT: Inside the food processing industry, peracetic acid and formaldehyde are two common disinfectants that are often used to kill common foodborne pathogens. Although they are widely accepted for its ability within the industry, research is being conducted to find a more environmentally friendly chemical with similar disinfectant properties that is safe and harmless to use. The purpose of this research is to evaluate and quantitate the efficacy of a hydrogen-peroxide based powder as a disinfectant against a variety of microbes, including bacteria and viruses. Testing is conducted on three 2x2 inch hard, non-porous tiles that have been inoculated with 100 µl of a high titer microbial suspension in the form of 10 µl drops and is set to dry for up to 1 hour. After drying, the disinfectant solution is applied on the tiles according to the manufacture's instruction using a 1:10 dilution. Samples are then collected before and after the disinfectant application by using swabs that contain 1 mL of a neutralizing broth. Afterwards samples were then assayed using standard methods. The disinfectant was shown to be 96% effective against MS2 virus, 99.9999% effective against E. coli, and 99.9999% against Salmonella. Hydrogen peroxide can be effective against microbes, particularly in use within the food processing industry, though more research needs to be conducted.

Ricardo Padilla Vera

University of Arizona, Mechanical Engineering

Mentor: Dr. Aaron J. Rosengren – Aerospace and Mechanical Engineering

Artificial Satellites in Cislunar Space

ASTRACT: Artificial satellites in cislunar space are satellites that orbit in the region between the Earth and the Moon. Satellites that orbit in this region are subject to forces other than just the Earth's gravitational pull. These forces that disturb a satellite's orbit are classified as perturbations. Such perturbations can come from Sun, Moon, Earth or other elements such as solar wind/radiation effects or electro-magnetic. These perturbations are well documented for Middle and Low Earth orbits. On the other hand, perturbations in High Earth Orbits (HEO) are not well understood making their trajectories and decay date to be inaccurate or unknown. In order to better comprehend these perturbations, we selected satellites in HEO to analyze. Space-Track.org, a database provided by the US Air Force. Provides information on satellite orbits. Data was gathered from this resource with the criteria of satellites being a distance of 44,646 km away from the earth's surface. Graphs were later developed to illustrate the evolution of all satellites in HEO in order to better visualize how these perturbations are affecting these particular satellites. 505 satellites were discovered that have orbited in our region of interest. This work will be handed off to a post-doctoral researcher who will handle the theoretical part of these perturbations in hopes to find more information on perturbations acting on HEO satellites.

Ashley Rau

University of Arizona, Bioinformatics

Mentor: Dr. David Baltrus – School of Plant Sciences

Identifying the CII Protein within *Erwinia amylovora* Bacteriophages

ASTRACT: As antibiotic resistant strands of bacteria continue to grow as a problem, alternatives are being sought to solve the issue in both animal and plant systems. One solution is known as bacteriophage therapy, but it is not without its own complications. Viruses that go through their lysogenic cycle do not immediately kill their host, which goes against the main point of the treatment. As a result, the purpose of this study is to look at bacteriophages that infect the bacteria *Erwinia amylovora*, a bacteria that causes the disease fire blight in apple and pear trees. This is an attempt to see if the bacteriophages contain a protein found in another bacteriophage, Enterobacteria phage Lambda, that when turned off, prevents lysogeny all together. The research was conducted by extracting DNA from infected *Erwinia amylovora* samples and running them through Nanopore. The reads were then cleaned up and assembled into full genomes, which were then ran against the CII protein found in the NCBI databank. The final results, however, showed that the protein was not present in the bacteriophages, suggesting that *E. amylovora* bacteriophages have their own proteins associated with lysogeny.

Crystal Raygoza

University of Arizona, Family Studies and Human Development

Mentor: Dr. Melissa Yvette Delgado – Family Studies and Human Development

Examining the Relation between Familismo and the Educational Outcomes of Latinx Middle School Adolescents

ASTRACT: The work on the association between familismo, strong family bonds (Sabogal et al., 1987), and academic outcomes demonstrate mixed findings in Latinx samples. For example, in a Latinx students' sample, Esparza and Sanchez (2008) does not find familismo as a significant predictor of academic outcomes (e.g., GPA); however, Niemeyer et al. (2009) and Toyokawa and Toyokawa (2019) did find familism was a positive predictor of academic achievement in a sample of Latinx adolescents. Therefore, the focus of this study is to examine the association between familismo and the educational outcomes of Latinx middle schoolers. Data come from a larger study on academic socialization. Participants were 288 (54% female, 86% US born) Latinx adolescents, interviewed when adolescents were in the 8th grade (Mage = 13.69 years, SD = .56). Adolescents reported their background information, familismo (Knight et al., 2009), academic aspirations, and grades. Regression analyses will be utilized to test the hypotheses: (a) higher levels of familismo predict higher levels of educational aspirations and (b) higher levels of familismo predict higher levels of academic performance. Findings of this study will help address current gaps in the literature, contributing to the evidence of the Latinx adolescent population and the correlation between the relationship of familsmo and educational outcomes. Findings from 288 Latinx 8th graders indicated that there was a significant association between higher levels of familismo and educational aspirations. Higher levels of familismo also positively associated to academic performance. The study will also address the limitations and implications of the study.

Soraya Sandoval

University of Arizona, Biochemistry, Molecular and Cellular Biology

Mentor: Dr. Brett A. Colson – Cellular and Molecular Medicine

Phosphorylation of Human Myosin Binding Protein-C and The Effects of Arthrogryposis Mutants on Actin Binding

ASTRACT: Myosin Binding Protein-C (MyBP-C) is a family of muscle regulatory proteins that includes slow skeletal (sMyBP-C), fast skeletal (fMyBP-C), and cardiac (cMyBP-C) isoforms. Additionally, sMyBP-C is expressed as long and short variants due to alternative splicing. Recently, the mutations W236R, P319L, and E359K in the MYBPC1 gene encoding sMyBP-C were identified to cause distal arthrogryposis (DA), but it remains unclear how these mutations affect protein function in the muscle sarcomere. Previous research has reported that both cMyBP-C and sMyBP-C are regulated in a phosphorylation-dependent manner, and act to modulate muscle contractility through interactions with myosin and actin. The aim of this study was to compare PKA phosphorylation of sMyBP-C and fMyBP-C, and actin binding properties of the pathological and normal states of long sMyBP-C. In order to ensure production of quality protein, we performed a protein solubility test which indicated that the DA mutations do not alter protein solubility. After treatment with PKA, phosphorylation was observed in long sMyBP-C at PKA concentrations comparable to that required for cMyBP-C, whereas phosphorylation did not occur in short sMyBP-C. Phosphorylation was observed in fMyBP-C only at very high concentrations of PKA. No significant differences were observed in actin binding properties of long sMyBP-C compared to its DA mutants. Interestingly, phosphorylation significantly reduced protein binding to actin for both wild-type and DA mutants. Overall, this study provides insight into the phosphorylation of human sMyBP-C by PKA, and the functional effects on actin binding due to phosphorylation and mutations that cause DA muscle disease.

Amadeus Toledo-Seitz

University of Arizona, Anthropology and Political Science

Mentor: Dr. Robert Schon and Jessica MacLellan – Anthropology

Universality of Kingships: ***Economy, Production, & Power in Bronze Age Mycenae and Classic Period Maya***

ASTRACT: Kingships and centralization have been a central focus of archaeological and anthropological research when attempting to decode societal structures in antiquity. Research often focuses on a singular period in a selected culture's history, leaving a vast swath of archaeological time by the wayside. Limited research also focuses on the foundational periods of early kingships and aristocracy and on attempting to create a useable model of cultural and societal structures and "artifacts" (a remnant of cultural norms and theorized interactions). Such a model would allow for easier classification of sites with minimal physical artifacts or archaeological records. This also allows for voids in the archaeological record to have a reference point from the available information. I posit a socio-economic analysis of two foundational periods during the burgeoning kingships of the Classic Period: Maya and Late Bronze Age Mycenae, allowing for a greater understanding of the societal structures and artifacts present at the time. Political structures, economic capabilities, and power dynamics between the two societies are analyzed to see if any similarities arose that may add to the prospective universal model of societal structures in antiquity. The research yielded many new data points and similarities that add to the prospective model, while work toward a cohesive and theoretically sound universal model of societal structures in antiquity requires much more research and application.

Ashley Varela

University of Arizona, Microbiology

Mentor: Dr. Melissa Halpern – Pediatric Department

Microbiome Analysis of the Intestinal Microbial Communities Found in Neonates who Develop Necrotizing Enterocolitis

ASTRACT: Necrotizing enterocolitis (NEC) is a leading cause of mortality and morbidity in premature infants. The pathogenesis of this disease is not well understood, but a major risk factor for the development of disease is intestinal dysbiosis. Research has also linked an accumulation of secondary bile acids in enterocytes to the development of NEC. Discrete bacterium have the operon which enables this bile acid transformation. We hypothesized that bacteria which were capable of converting primary bile acids to their secondary form would be in greater proportion in the neonates who developed NEC when compared to those who did not. Fecal samples of nine preterm infants who developed NEC and nine matched control infants who did not, were used for comparison of the microbiota composition. Matching was based upon gestational age, birth weight, and date enteral feeding commenced. Five fecal samples were taken from each patient, which then underwent DNA extraction, followed by purification for high quality samples. Samples have undergone PCR and are in the process of genomic analysis for identification of bacteria. The data obtained can then suggest whether the proportion of bile acid converting bacteria can indicate the likelihood of a neonate developing NEC. If our hypothesis proves true further research can be performed to possibly be used a diagnostic tool. If our hypothesis proves false further research must be performed to determine whether intestinal dysbiosis found in NEC cases are a symptom or a cause of the disease.

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Density Focused Algorithm to Accurately Filter Noise in Gaps during LiDAR - Based Mapping

ASTRACT: Developments in signal processing have been essential in advancing the capability of robots and autonomous systems to negotiate unknown environments. In such environments, an autonomous robot must make decisions on the basis of imperfect knowledge using noisy sensor data. This research focuses on the improvement mapping of gaps between non-uniform or asymmetrical obstacles with minimal domain knowledge. We use a density distribution-based algorithm to accurately measure gaps between obstacles using data from an onboard LiDAR and ground-truth data from a Vicon motion capture system. The algorithm resulted in reducing over half the storage size of any path taken and recognizing gaps as small as 0.1m, and mainly mapping those points with high density.

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Wireless, Battery-free, and Subdermally Implantable Tool for Real-time Dopamine Dynamics Investigation with Optogenetic Interrogation Capabilities

ASTRACT: Dopamine is a neurotransmitter that plays an essential role in the brain's micro and macro circuit level behavior. Dopamine sensing in freely moving animals is restricted to bulky sensing platforms with limited runtimes. Wired solutions featuring dopamine sensing and electrophysiological recordings show the utility of such multimodal systems, but to analyze circuits seamlessly and ideally, a subdermally implanted system featuring stimulation capabilities with cell specificity is needed. To enable recording and simultaneous stimulation in freely moving subjects, we demonstrate a highly miniaturized platform that omits the need of a battery power supply by using resonant magnetic coupling to power the device. The soft and flexible platform includes the capability to optogenetically stimulate and record dopamine dynamics simultaneously, while relaying information digitally via infrared communication. The monolithically integrated probe, based on flexible filaments, features high sensitivity dopamine sensors and micro-LED based optogenetic stimulation in a footprint smaller than multimodal fibers used in comparable tethered approaches. Here we show detailed electromagnetic characterization of the system with ex vivo recordings of wireless and battery free devices demonstrating advanced capabilities for the dissection of neural circuits in freely behaving animal models.