

# UROP 2017-2018 Abstracts presented a RaCAS

## April 27, 2018

### Exploring a Food Environment and Food Related Behavior in Skagway, Alaska

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**Faculty Mentor(s):**

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**Abstract:**

In my ethnographic study, I assessed the nutritional adequacy of restaurants and grocery stores in Skagway, while also exploring the ways in which Skagway's food environment and seasonal tourist economy effected food related behavior amongst the seasonal employee and local resident population of Skagway. As the number of dietary related diseases in the US continues to increase, many studies have been devoted to addressing food security and factors that influence food related behavior. However, areas such as Skagway, which are heavily reliant on tourism yet geographically isolated, tend to get overlooked. Using a mixed methods approach I learned more about food related behavior within the population through participant observation and semistructured interviews. To assess the consumer nutrition environments in Skagway, I used a Nutrition Environment Measures Survey (NEMS), which scores food outlets on the availability, quality, and cost of fresh fruits and vegetables. I was able to gain further insight as to how the population of Skagway perceived the nutrition environment by administering surveys. Many food outlets had a low NEMS scoring, but the food environment had less of an impact on behavior than I had anticipated. My findings suggest that food choice was influenced more by social and occupational factors. Individuals with strong social bonds (and therefore people to cook and share food with) reported having diets comprised of high quality foods, such as fruits and vegetables; in comparison to individuals that reported a lack of social connectedness, as they opted for more low quality and prepackaged foods.

### Osteogenic Response to Exercise with Obesity (OREO)

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**Abstract:**

Obesity is commonly associated with better bone health because additional weight is carried by the skeleton. However, physical inactivity and a high fat diet (HFD) can lower peak bone mass, and increase bone loss during adulthood. Exercise is expected to improve bone health, but obesity may impair the beneficial adaptations to exercise. 32 female rats were fed HFD (6 months) to establish an obesity prone (Obese) and obesity resistant (Lean) phenotype. Rats were then calorically restricted to induce and maintain a 15-18% weight loss with a medium fat diet plus treadmill exercise (EX: 8-10 wk, 1 h/d, 6 d/wk at 15 m/min) or sedentary control (SED). Body composition was measured using quantitative magnetic resonance. Characteristics of hindlimb bones were quantified with microcomputed tomography, mechanical testing, and finite element modeling. Lean mass was positively correlated ( $r=0.36-0.72$ ) with all tibia outcomes. Fat mass was not correlated with bone parameters. Obese had more fat mass and tended ( $p=0.064$ ) to have more lean mass than Lean. Unadjusted bone parameters were similar among Lean and Obese. When adjusting for lean mass, Lean had a higher minimum bending resistance ( $I_{min}$ ), minimum modulus ( $Z_{min}$ ), and energy-to-failure ( $p<0.05$ ). Cross-sectional area, cortical thickness, and  $Z_{min}$  increased ( $p=0.01-0.04$ ) with exercise. The effect of exercise on  $I_{min}$  and polar modulus ( $Z_{pol}$ ) became significant ( $p<0.05$ ) when adjusting for lean mass. Increased lean mass was predictive of bone health, but may obscure deficiencies in bone associated with diet-induced obesity and Exercise can improve bone health similarly among Lean and Obese rats.

## **Differentiation of SH-SY5Y cell line in bioprinted 3-D culture**

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**Abstract:**

Maintaining cell cultures in 2D cell environments, such as flasks or petri dishes, negatively affects experimental results, as 2D cultures don't represent native cellular environment adequately. Notable success in improving in vivo mimicry was achieved by bioprinting 3D culture constructs, primarily tumor models for cancer research; however, to date, physiologically relevant artificial models for application in neuroscience-related research are underrepresented; currently available neuron cultures have high maintenance cost and require intricate handling. Consequently, there is a need for a method to generate cost effective and easy to handle models for neuroscience research that are more representative of native cellular environment than existing artificial models. In this study, SH-SY5Y neuroblastoma cell line was combined with gelMA and photoinitiator to create a cell-laden bioink that was subsequently bioprinted to form 3D culture constructs. The cells used for the bioink were

differentiated, that is, driven towards neural phenotype, pre-printing and post-printing. The results in two groups will be compared in order to determine the optimal time of differentiation.

## **Effect of Socioeconomic Status on Emergency Department Length of Stay and Crowding**

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### **Abstract:**

In 2012, the Centers for Medicare and Medicaid Systems began collecting data on emergency department length of stay as part of performance evaluation, with longer length of stay as a sign of poor performance on timeliness. While the goal of reducing emergency room crowding is justified, using length of stay as a performance measure overlooks factors that are out of the control of emergency departments. There is evidence that patients with low socioeconomic status tend to utilize emergency departments more often. We hypothesize that low socioeconomic status patients also have longer lengths of stay in the emergency department. If so, using the length of stay as a performance index can penalize hospitals that serve larger percentages of low socioeconomic populations. In this research, we test the hypothesis that patients with lower socioeconomic status have a longer length of stay in emergency departments by gathering original data. This study enrolls 300 patients at Lutheran Medical Center in Denver, Colorado and collects: annual income, number of people in the household, educational level, and occupation. These data are used to tabulate a socioeconomic index that is correlated with length of stay, which we obtain from their medical record following consent. We control for possible confounders of insurance status, whether patients had a primary care physician, and the number of diagnostic tests ordered in the emergency department. The aim of this study is to test the above hypothesis with the goal of identifying areas where intervention may have a lasting impact on reducing crowding.

## **The Power of Images: Decoding the Relationship between Iconography, Symbols, and Ideology of the Ancient World's Mystery Cults and the Emerging Formation of Early Christianity**

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**Abstract:**

The relationship between the religion of Christianity and the mystery cults of the gods Dionysus and Mithras during the Roman empire has been hotly contested, debated and analyzed for a thousand years, from commentary by ancient writers such as Clement and Origen to modern scholars. However, there has yet to be a comprehensive study on the visual artifacts these religions produced, thereby shadowing an important dynamic concerning the influences and appropriation between the two. My research fills this gap in scholarship by examining the religious iconography of the early Christians in conjunction with that of Dionysus and Mithras. Specifically, early Christian funerary art from roughly 200 C.E. onward will be examined and compared with contemporaneous and preceding Mithraic and Dionysian iconography. By analyzing the visual evidence through this paradigm, it will become evident that the early Christians, through their iconography, appropriated and absorbed mystery cult imagery relating to the gods Dionysus and Mithras. In doing so, aspects of early Christian art operated to both assimilate new converts and imbue their own faith and deity, Jesus Christ, with pagan-derived divine attributes. This project, by closely examining the significance and meaning of mystery cult-inspired iconography in early Christian art, will shed new light on the complicated and influential relationship between the ancient pagan world, specifically of the Dionysian and Mithraic mystery religions, and the burgeoning Christian faith.

## **Sex Differences in Endotoxin-Induced Neonatal Lung Injury: Insights into the Pathogenesis of Bronchopulmonary Dysplasia**

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**Abstract:**

Bronchopulmonary Dysplasia (BPD) is a chronic lung disease affecting the premature population. Research in our lab focuses on the pathogenesis of BPD. Inflammatory stress is a contributing factor for developing BPD; Supplemental oxygen and ventilation machines are frequently utilized to help a baby grow throughout their early gestational age. It is known that males are more susceptible to certain types of lung injury. This finding then leads us to question: How does lung development differ in males and females following exposure to inflammatory stress?

The protocol followed for this experiment involves using murine models and giving an intraperitoneal injection of LPS –an endotoxin that initiates an inflammatory response- followed by monitoring their survival. It is important to begin by knowing what mice are females or males. This can be identified by genotyping mice and looking for the SRY gene –a gene found only in the Y chromosome- that lets us

identify who is male or female. After knowing the sex of each of the mice genotyped, we collect their lungs and inflate them. The lungs are then sent to a histology lab for them to be stained and put into microscope slides. Once ready, we take pictures of the peripheral section of a lung and use radial alveolar counts (RAC) and mean linear intercept (MLI) as objective measures of lung development. The result of this experiment will help us determine if there are sex-specific differences how the innate immune response to inflammatory stress affects the developing lung.

## **Activation of Oxytocin Neurons in the Paraventricular Nucleus of the Hypothalamus of Male Rats exposed to Post-weaning Social Isolation and Conditioned Social Fear**

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### **Abstract:**

Social interactions and human connection are reported to improve well-being and longevity while increasing human resistance to biological diseases (Eisenberger and Cole, 2012). Early life adversity, which often includes disrupted social-interactions, has been linked to depression and anxiety (Cohen et al., 2001). Human trust and bonding have been associated with oxytocin, which regulates pro-social behavior and relieves anxiety. Somewhat paradoxically, some studies indicate that oxytocin may modulate antisocial and aggressive behaviors (DeWall et al., 2014; Shamay-Tsoory and Abu-Akel, 2016). Male Sprague-Dawley rats were assigned to one of two housing groups Post Weaning Social Isolation (PSI) or Social Reared (SR). After four weeks a novel social fear-conditioning was completed with the rats either assigned to the fear conditioning or one of two controls. This study assessed behavior and the activation of oxytocin neurons in the paraventricular nucleus of the hypothalamus. The behavior analysis presented a significant main effect of housing with the PSI group being more aggressive than the socially reared (SR) group. The social fear conditioning produced a significant main effect of housing by condition with an increase in aggressive grooming by the male SR group. A double-label immunohistochemistry (IHC) assay was completed to identify phosphorylated CREB, which is used as a neuronal activation marker, and oxytocin. The double IHC allowed for the quantification of activated oxytocin neurons. The data indicated a main effect of housing with the PSI group having a higher percentage of activated oxytocin neurons compared to the SR group.

## **Train Riders: The Modern Day American Nomads**

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### **Abstract:**

Many research papers and ethnographies cover homelessness but not many go over the different types of homelessness. My research covers nomadic homeless lifestyles, primarily younger people who travel across America using different modes of transportation. Members of the group identify with the names such as dirty kids, travelers, and train riders, all of which relate to the lifestyle. Although homeless, this group travels across the country hitch-hiking and riding freight trains. This paper analyzes the paradox of the freedom of the road and the fatal dangers of this lifestyle. This paper is written from an autoethnographic viewpoint to elaborate this lifestyle from a first-hand experience.

## **Formation of Protein Coronas on Metallic Nanoparticles and Removal of Metallic Cores**

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### **Abstract:**

The binding of proteins to metal nanoparticles results in a protein corona surrounding the core of the nanoparticle. The resultant materials are toxic, although it is unknown whether the metallic nanoparticles themselves or the mis-folding of proteins within the corona produces this toxicity. We seek to investigate the relative toxicity of uncoated metallic nanoparticles, metallic nanoparticles encapsulated in a protein corona, and the protein corona absent the metallic core. Silver nanoparticles were synthesized using tannic acid and trisodium citrate and gold nanoparticles were synthesized via reduction of chloroauric acid with trisodium citrate. Nanoparticles were encapsulated in C-reactive protein (CRP) as a model serum protein. Localized surface plasmon resonance measurements were used to optimize the amount of CRP needed to form the protein corona and to determine the amount of cross-linking agent required to covalently link CRP into a continuous shell. A technique was developed for removing the metallic core using a cyanide etch and the resulting corona was purified with dialysis prior to toxicology studies. The characterization of the nanoparticles and their protein corona with dynamic light scattering and ultraviolet-visible spectroscopy will be presented.

## **Stereological Analysis to Determine the Structural Basis for Loss of Gas Exchange**

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### **Abstract:**

Asthma is a chronic respiratory disease affecting 1 in 13 Americans with healthcare costs of \$56 billion dollars a year. Environmental factors can cause an increase in severity of the inflammation leading to reversible airway obstruction and hyperactivity that result in approximately 10 deaths per day. Preclinical development of new treatment strategies for severe asthma hinges on the use of animal models. However, in order to assess the efficacy of novel treatments we must first understand the structural and functional changes that characterize these asthma models. We have therefore developed techniques to quantify alveolar size, inflammation severity, and the surface area available for gas exchange. The analysis of three different cohorts of mice that were exposed to intratracheal (IT) instillations of saline (control), house dust mite (Group 1), and freund's adjuvant (Group 2). Asthma severity was assessed by measuring bronchoconstriction following inhalation of nebulized methacholine using the forced oscillation technique. The functional state of the lung was also quantified by measuring carbon monoxide diffusing capacity (DFCO). The formalin-fixed lung samples were then paraffin embedded and 5  $\mu\text{m}$  sections were stained with hematoxylin and eosin. Images selected via systematic uniform random sampling were used to estimate the volume fraction of parenchyma in four classes of graded inflammation. The gas exchange area per unit volume was determined using line intercepts and the volume weighted average alveolar volume was calculated using point sampled intercepts. These measurements allow correlation of mechanical and gas-exchange function to the structural changes caused by allergen exposure.

## **Drawing as a Learning Tool in Undergraduate Microbiology Education**

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**Abstract:**

In biology education research, there are few studies focused on the use of drawings to improve educational outcomes. Here, we propose that drawing is a fundamental learning tool in the sciences. We demonstrate the functionality of drawing as an educational practice to improve student understanding and to develop skills of creation and interpretation of visual models. Layers of contextual, spatial, and process information can be captured through drawing. This creation of a complex drawing model can aid students in critical thinking and problem solving situations. The process of creating a drawing is metacognitive, which has been shown to improve student performance and independence. Overall, the skills developed through drawing are vital in the transition from novice to expert learners. With an increased understanding of drawing in STEM education we can provide students with the tools necessary to succeed in their academic and professional science careers.

**Evidence of ant-mediated seed dispersal in Colorado Front Range populations of Lilac Penstemon (*Penstemon gracilis* Nutt., Plantaginaceae)****Student Authors:**

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**Abstract:**

Mutualistic relationships (mutualisms) are those that benefits all species involved. One type of mutualism, myrmecochory, involves dispersal of seeds by ants, which has resulted in the evolution of certain traits that facilitate these relationships. With myrmecochory, one such trait is the presence of a structure referred to as an elaiosome, composed of substances (e.g., fatty acids, lipids) that attract ants to seeds. The seed is brought to the nest, elaiosome consumed, and the seed either discarded in the tunnels of the nest or just outside. This behavior can aid in the survival of the seedling by reducing potentially negative effects of density-dependent factors such as competition, as well as aiding in avoidance of predation. Studies have shown that among myrmecochorous plants, elaiosome size normally increases with seed size, and influences rate of dispersal. Various fatty acids have been shown to attract ants to disperse seeds, often without a proportional reward. This study investigates the relative size and chemical composition of elaiosome-like structures in Lilac Penstemon (*Penstemon gracilis*) along the Front Range of Colorado. Assay via gas chromatography revealed the presence of linoleic acid, a fatty acid that Hymenoptera (bees, wasps, ants) are unable to synthesize and therefore must incorporate into their diet. Linoleic acid is present in the elaiosome of other known myrmecochorous seeds. The relative size of the seed is significantly smaller than previously documented myrmecochorous species however the trend seen in other studies is still followed. Overall, this study reveals evidence for the development of a myrmecochorous relationship.

## **Concentric Annular Ring Slot Antenna (CARSA) for Non-Invasive Blood Glucose Monitoring**

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### **Abstract:**

Blood glucose monitoring is an important part of patient care which traditionally involves physically drawing blood. The process of drawing blood can be painful and intrusive, which predicates the necessity of a non-invasive monitoring method. One method for reliable collection of blood glucose levels is through impedance spectroscopy, which uses the correlation between blood glucose levels and impedance through the top layers of the skin to determine blood glucose levels. Ruwansiri, Kulasekera, Senarathna, Dayawansa's research, "Evaluation of Compact CARSA Sensor and Penetration Depth of EM Signal for Non-Invasive Blood Glucose Measurement" demonstrates that a small antenna sampling a shallow portion of skin at 25-42 MHz is more accurate than a large sensor, which inherently interacts with deeper layers of the skin. Their study concluded that the smallest sensor tested was the most accurate. For this reason, my research focused on replicating results presented by Ruwansiri et al. in addition to testing a CARSA slightly smaller than the most accurate sensor presented through their research. The tested sensors were milled from copper plated plastic sheets and measurements were taken using an ENA Network Analyzer. In order to interface with the Network Analyzer the sensors were fitted with SubMiniature version A (SMA) connectors (semi-precision coaxial RF connectors). In order to confirm measurements from Ruwansiri et al. the two smallest sensors from their research have been reproduced. By testing an even smaller CARSA sensor, this project aimed to demonstrate that accurate Non-Invasive Blood Glucose Monitoring can be achieved by means of extremely compact sensors. Data was collected in order to demonstrate that the sensors performed as expected and clinical trials would assist in establishing a more precise correlation coefficient.

## **3D Printed Custom Mask For Pediatric Sleep Apnea Therapy**

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**Abstract:**

The purpose of the project is to create patient specific continuous positive airway pressure (CPAP) masks. With the use of 3D imaging scanning, computer aided design (CAD) and 3D printing a custom printed CPAP mask can be created for any individual. Children's Hospital Colorado has a 3dMD face scanner that was used to capture a subjects face. Scans can be transferred onto CAD platforms such as Geomagic and Solidworks. Once the design of the mask has been fitted to the facial images provided from the 3D images actual 3D masks can be 3D printed. Results show that the process of utilizing 3D printing to create a custom CPAP mask is feasible and could be used for a wide range of patients that suffer from cranial facial abnormalities. First, a reliable scanner was needed to ensure that a complete facial recognition can be generated. Second, the 3D image is uploaded onto CAD software to construct the actual mask. Finally, the mask is fitted to the 3D image provided the CAD file can be build on a 3D printing platform. Future work to be completed on the project are to enhance the cushion feature of the mask, create molds of the actual mask for softer wearable materials and actual patient trials are needed. For actual patient use to finally be achieved all steps in the above statements need to be highly precise fitting for the individual.

## **Experiential Learning in the European Union: An Investigation of Ambisonic Content Creation, Live Music Broadcasting, and Live Music Industry**

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**Abstract:**

The European Union has one of the most vibrant and active live-music scenes in the world. That energy puts their industry on the vanguard of technological development for ambisonic sound engineering. My research targeted this cutting-edge knowledge in Germany and revealed the ideal functionality and utilization of a high order ambisonic system. Ambisonics describes the utilization of audio sources to create a three dimensional, fully immersive soundscape. The majority of my ambisonic research was conducted at HAW Hamburg, Faculty of Design, Media, and Information; which houses a 29 speaker system that provided a highly specific localization of audio sources in a soundscape. I utilized the digital audio workstation, Reaper, to manipulate audio to create either channel-based or sound-field based results. My results were facilitated through the use of plugins created by Mattias Kronlacher. I utilized these plugins not only to create sound fields, but also to decode an ambisonic recording of La Bohme, an opera by Puccini. While at HAW I also researched the workflow of live music broadcasting, in a case study of MUTESOLO. Equipment used included Vister X mixing console for mastering, black magic router for broadcasting, and other rudimentary sound recording devices. Additionally my research included a live performance in Copenhagen. This experiential research provided knowledge of venues in Copenhagen, crowd and cultural expectation, basis of payment and venue funding, and booking

experience. The performance occurred at Studenterhuset, a music venue and coffee house organized by students. This experience emphasized funding and how that relates to a live performers success.

### **3,4-methylenedioxyamphetamine (MDMA) impairs the extinction and reconsolidation of fear memory in rats**

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#### **Abstract:**

Clinical trials have demonstrated that 3,4-methylenedioxyamphetamine (MDMA) paired with psychotherapy reduces symptoms of post-traumatic stress disorder (PTSD) more effectively than psychotherapy or typical pharmacotherapy, either alone or in combination. However, the mechanisms by which MDMA might enhance psychotherapy remain unclear. Given that fear memories contribute to PTSD symptomology, MDMA could augment psychotherapy by neurochemically targeting fear memories. These current studies investigated the effects of a single administration of MDMA on extinction and reconsolidation of fear memory in adult male Long-Evans rats. Rats were exposed to contextual or auditory fear conditioning, followed by systemic administration of saline or 1,2,3,5, or 10 mg/kg MDMA either 30 min before auditory fear extinction training, or immediately after contextual fear memory recall (i.e. during the reconsolidation phase). MDMA (5 mg/kg) reduced later recall of contextual fear memory during a drug-free memory test, but only if administered during the reconsolidation phase. MDMA failed to enhance fear extinction, and in fact 3 and 10 mg/kg MDMA impaired drug-free fear extinction recall. These findings are consistent with a general memory-disrupting effect of MDMA, and suggest that MDMA could augment psychotherapy by impairing the reconsolidation of recalled fear memories, without necessarily enhancing their extinction.

## **Personalized Medicine & Pressure Ulcer Prevention**

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### **Abstract:**

Pressure ulcers are severe open wound injuries to the skin and tissue as a result of prolonged pressure and deformation. This may occur more frequently over bony prominences, such as the ischial tuberosity whilst sitting. For wheelchair users, such deformations are observed in the buttocks tissues due to long hours of wheelchair use. Pressure ulcers greatly decrease the quality of life of such wheelchair users, impairing health, daily activities, and employment of those affected. Treatment of pressure ulcers has an estimated cost of \$100,000 for a single ulcer, which an individual may develop multiple times. Personalized medicine is a procedure which separates patients in different groups based on their risk of disease or response to therapy. This allows for the development of a treatment plan that is catered to the individual based on their past history. By using new measurement techniques developed at Georgia Institute of Technology in observing tissue deformation, personalized medicine can be applied to measure risk of developing and preventing pressure ulcers. As one of the data collection centers located in Denver (the other located in Kessler, NJ), clinical and MRI sessions are being held to gather data that will be used to make connections between pressure ulcer history and risk factors (called Biomechanical Risk, which is the characteristic of an individual's soft tissues to deform in response to external force).

## **Effect of physical activity on cricket behavior**

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**Abstract:**

Physical activity in mammals has been shown to modulate behaviors important for survival by acting on monoamine neurotransmitters, such as dopamine and norepinephrine. Monoaminergic systems are present in invertebrate species; however, little is known about the effects of physical activity on monoamine-dependent survival behaviors in non-mammalian species. This is an important question, as factors related to activity can contribute to fitness, health and survival of species. In the common house cricket (*Acheta domesticus*), the norepinephrine analog octopamine is involved with experience-dependent changes in survival behaviors, such as aggressive behavior and bite-force. By exposing crickets to aggressive confrontations followed by exercise, we plan to determine the effects of exercise on the bite-force capacity of the defeated and non-defeated crickets in male common house crickets. A Tekscan Flexiforce Measurement System was used to determine bite-force in which crickets bit a thin sensor, and recorded the force in Newtons. Pilot studies were conducted to determine the optimal rate and duration of exercise to be 260 cm/min for 10 minutes.

Data is currently being collected to determine whether physical activity increases bite force following an aggressive confrontation. Initial data suggests that following aggressive behavior, cricket bite force increased in those deemed non-defeated, and exercise further increased their bite force. A decrease in bite force was observed in crickets that were defeated, while exercise had variable effects. Further studies will be conducted to determine whether exercise restores bite force in the defeated cricket.

## **Designing Primers For the Selective Enrichment of Low Abundance Environmental Microbes**

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**Abstract:**

Information contained in the genome of a bacteria or archaea illuminate the origins of eukaryotic life, lead to new pharmaceutical developments, and inform our climate change models. Shotgun metagenomics involves gathering an environmental sample such as soil, water, rock, etc., breaking up the genetic material into small fragments, and then sequencing as many of these small fragments of DNA as possible. Once these short sequencing “reads” are generated they need to be assembled into complete genomes. Trying to assemble genomes for organisms that are low abundance in the sample often results in fragmented genomes, missing key genes and predicted functions. Our primary goal in this experiment is to target and enrich one of these less abundant species with the ultimate goal of inferring its function in the environment. In our experiment we are interested in a low-abundance archaea known as ANME-2D found in a wetlands ecosystem. ANME-2D is predicted to be a vital component of the methane cycle in this, and other environments. Using input data from the existing low quality ANME-2D assembly, we wrote the SWGA program. This program designs primers targeted to the ends of the existing fragments. These primers were used to guide phi 29 polymerase in a multiple displacement amplification reaction, the goal being to selectively amplify regions of the ANME-2D

genome that were not covered in the original assembly. Preliminary analysis indicates that some enrichment of the ANME-2D DNA was achieved. Future analysis of the improved ANME-2D genome will clarify its functional role in the methane cycle.

## **The Role of Implicit and Explicit Memory in Visual Search Performance**

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### **Abstract:**

While engaging in our everyday environment, we visually encode the surroundings using implicit or explicit memory processing. These memories can then go on to influence our responses. In the current study, we are interested in examining individual differences in these memory systems. Priming is an implicit memory effect where exposure to one stimulus can influence a response to a subsequent stimulus. Previous studies reveal that the response to a pop out target is faster and more accurate when the target color is repeated on consecutive trials. When the target color switches in subsequent trials, individuals respond slower with less accuracy. One goal of this experiment was to use a priming of pop out paradigm to investigate individual differences in how priming changes when the likelihood of repetition changes. In terms of individual differences, it is well known that individuals also vary in working memory capacity, which is a more explicit form of memory. In our task, working memory was measured using a change detection task where participants had to identify a color that changed between visual displays presented at different times. We hypothesized that working memory capacity would correlate with priming in the pop out search task. Our results found faster reaction times with repeated stimulus than switched, which replicates previous findings, but no effect of probability. We found there was a trend for a relationship such that those with higher working memory had lower priming.

## **Historical Occurrence of Intersex in Fish**

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Dr. David Norris, Professor Emeritus, CU Boulder

**Abstract:**

The primary objective of this project was to utilize museum collections to determine whether the recently observed high incidence of intersex in largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*) precedes the widespread use of synthetic estrogenic contaminants. Gonad samples of these species between 50, and 188 years ago were obtained from museum collections and analyzed. The tissues were dehydrated in a graded series of alcohol, embedded in paraffin wax and sectioned with a microtome. Slides were stained with hematoxylin and eosin, and coverslipped before microscopic evaluation. Investigation of archived museum samples to address long-term trends in the effects of environmental contaminants. Initial observations indicate that although intersex was found in historical samples, this condition was less prevalent and less severe compared to modern samples. These findings were utilized as a baseline for intersex occurrence. Further research will focus on analyzing the increase in intersex occurrence over the years in order to relate historical trends in intersex to historical trends in environmental contamination.

## **Assessment of Subject's Willingness to Participate in Rheumatoid Arthritis (RA) Prevention Studies: Research Participation Influences (RPI) Study**

**Student Authors:**

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**Abstract:**

Rheumatoid arthritis (RA) is an autoimmune disease that causes joint inflammation and damage. It is known that an autoantibody blood marker called 'anti-CCP' is present in the blood years prior to the development of clinically apparent RA. StopRA is a randomized, placebo controlled clinical trial in individuals who are anti-CCP positive to determine if taking the RA drug hydroxychloroquine for one year can prevent or delay progression of clinically-apparent RA. It is unknown, however, how subjects will respond when asked to participate. The Research Participation Influences (RPI) study is being

performed in parallel with StopRA with the goal of understanding what factors influence a study subject's willingness to participate in an RA prevention study. The RPI Study administers questionnaires online through SurveyMonkey and through phone interviews to individuals who are eligible for StopRA and have chosen to participate, or not. These questions evaluate a subject's reasons for participating (or not). Since the start of RPI on 3 June 2016, 42 subjects who were offered participation in StopRA completed the RPI survey. Before we perform in-depth analyses, we would like to enroll additional subjects. Possible reasons for this loss of capture includes potential misunderstanding of the study and consent forms. Specifically, upon reviewing the on-line consent for RPI, many people click decline, which stops the study. To correct this, a better explanation of the process will be added to the emails that contain the survey link. Once we correct this issue, we will continue with planned enrollment and complete full analyses.

## **DNA Methylation level of OXTR SNP genotypes: Influence Altruistic Behavior**

### **Student Authors:**

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### **Abstract:**

Altruistic behaviors are important for human society to function well. Levels of altruistic behavior vary greatly between individuals due to the influence of both genetic and environmental factors. Our lab has previously found that the magnitude of a person's neural response, as measured using EEG scalp recordings, differs across people possessing different single nucleotide polymorphism (SNP) genotypes on their oxytocin gene receptor (OXTR) when shown negative pictures. Further, there was a significant correlation between a person's EEG response to negative pictures and their level of self-report altruism, measured using a survey on altruistic behavior. Given these findings, that there seems to be a genetic factor that influences both neurophysiology and level of self-reported altruistic behavior, we hypothesize that there may also be an environmental influence acting on the OXTR. To address this question, we postulate that levels of DNA methylation on the OXTR potentially also correlate with participants' EEG response and / or their reported altruistic level. The DNA methylation measurement procedure has not yet been performed on the DNA samples, however we believe that individuals with the GG allele genotype may express higher levels of DNA methylation in comparison to A allele carriers. We plan to perform the DNA methylation measures this semester to get the data that we need to test our hypotheses. If the results support our hypotheses, this will imply an interaction between a person's environmental experience, and changes in levels of DNA methylation. More importantly, in turn, differences in DNA methylation level may alter brain physiology and altruistic behavior.

## **A numerical method for elucidating the chest wall's non-linear elastic contribution to respiration**

### **Student Authors:**

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Matthew M. Kiselevach  
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### **Faculty Mentor(s):**

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### **Abstract:**

Improved ventilation has decreased mortality rates for patients with acute respiratory distress syndrome (ARDS) from 80% to nearly 40%, but the lack of individualized ventilation patterns has prevented reducing the mortality rate further. Ventilator induced lung injury (VILI) is one of the main contributors to mortality in ARDS patients and can be prevented by keeping alveoli open using positive end expiratory pressures (PEEP) to prevent atelectrauma, while also preventing overdistension and volutrauma. In order to understand the pathogenesis of ARDS and VILI, morphometry is used to analyze lung structure over a range of airway pressures. However, this approach requires preserving physiological volumes. The airspace volumes in fixed tissue are dependent on the airway pressure at the time of fixation. Because perfusion fixation may be performed with the chest wall of the mouse retracted to provide surgical access, the contribution of the chest wall to pulmonary system mechanics must be accounted for in order to achieve the desired state of lung inflation. To this end we have implemented a numerical model that translates airway pressures in open-chested mice to an equivalent airway pressure in a normal, closed-chested mouse. Pressure-volume loops were measured in 5 mice with the chest wall intact and retracted. A single compartment viscoelastic model was then numerically fit to the data in order. The simulations demonstrate that at low airway pressures the chest wall serves to maintain patency. As airway pressure is increased the stiffness of the chest wall increases nonlinearly and restricts expansion of the lung.

## **A Real-Time Framework for Semantic SLAM**

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**Abstract:**

Simultaneous Localization and Mapping (SLAM) is a computational problem where an agent (e.g., an aerial or terrestrial robot) autonomously explores an unknown environment to construct a map of the environment using sensor data, while simultaneously keeping track of its location within the map. SLAM is a computationally hard "chicken-and-egg" problem with numerous applications in disaster response, autonomous vehicle navigation, and bomb threat response. In particular, a real-time SLAM framework balances the trade-off of map accuracy and robustness with real-time execution constraints. With this research and development project, we introduce and implement a real-time semantic SLAM framework, where map construction is augmented by on-the-fly object recognition to produce semantic labels within the map. Our proposed semantic SLAM framework enables an indoor land vehicle, equipped with both depth sensor and RGB camera, to efficiently and autonomously explore and map an arbitrary unknown environment. Our implementation uses a graph-based algorithm for map construction, along with a deep learning component, (namely, a convolutional neural network (CNN)) to recognize and classify objects in real-time. To demonstrate a specific application of our real-time semantic SLAM framework, we extend the implementation by introducing a machine learning based anomaly detection algorithm that uses the constructed semantic map (including the recognized and classified objects) to detect and report anomalous presence of objects in the environment. Such an extended SLAM framework is applicable in numerous scenarios, e.g., can be deployed on a security patrol robot to detect abandoned baggage in a terminal or an active shooter on campus.

## **Development of volume-changing shape memory polymer to promote bone regeneration**

**Student Authors:**

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**Faculty Mentor(s):**

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**Abstract:**

In this research I exploited the properties shape-memory polymers (SMPs) to regenerate bone in amorphous defects. The physical and chemical composition determined the rigidity and shape-memory effect (SME) exhibited in polymeric materials. These materials were subjected to physical and chemical

stimuli to obtain an optimal SME. Polymer properties were optimized by changing the chemical structure and catalysts involved in each reaction. Porous structures decreased the volume of the polymer by increasing the vacancy. Porosity changed with material structure, and the ability of the solvent to promote material dissolution. The results of this process were verified by SEM microscopy and percent volume change of the SMP. A few studies have suggested that optimal bone regeneration is dependent on the pore size of the polymer. In contrast, this research focused on the porosity and pore size required to develop the optimal SME in bone regeneration applications.

## **Exploring Recurrent Neural Networks (RNNs) to Recognize Human Gestures in Edge Computing Environments**

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### **Abstract:**

The goal of the project is to identify a set of general human gestures and activities in edge computing scenarios. Edge computing is any computer environment in which data processing occurs at the edge of the network generally characterized with limited connectivity to high-performance centralized or cloud systems. The research project deploys an edge camera system with BodySLAM (Body Simultaneous Localization and Mapping), a deep neural network framework comprised of both convolutional neural networks (CNNs) and fully connected networks (FCNs) trained to detect human position of body joints segments (arms, legs, head, etc.) BodySLAM generates in real-time the human joint positions as a set of 3D (x,y,z) points over short time durations. The primary project work investigates the training and building of a new recurrent neural network (RNN) to characterize simple human movements (raising a hand, reaching out, waving, or crouching) from the BodySLAM pose results. An RNN is a class of artificial neural network that can capture connections between a sequence of data to detect temporal behavior over a time sequence. The platform used is an NVIDIA TX2 with on-board graphics processing unit (GPU) that can execute 2 TFLOPS (trillion floating point operations per second) and relay simple event results of a scene. The resulting edge computing system impacts many enable new automated opportunities to assess worker efficiency, detect unsafe scenarios, and judge athletic performance.

## **A Computational Study of the Villin Headpiece Subdomain HP-36**

### **Student Authors:**

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**Abstract:**

Hydrophobic side chain interactions are a major dynamic force in the folding of globular proteins and the aggregation of many non-globular proteins. HP-36, a headpiece subdomain on villin, has a hydrophobic core ideal for studying side chain interactions similar to those found in more complex proteins. The internal motions of the hydrophobic core residues have yet to be detailed. Solid-state NMR of 3 phenylalanine residues (F47, F51, and F58) implies the three residues are flexible and undergo frequent ring flipping. However, preliminary computational results suggested F58 was an order of magnitude less flexible than F47 or F51. Biased molecular simulations, which use biasing potentials to enhance sampling, were used to investigate the motions of these three phenylalanine residues within the hydrophobic core of HP-36. Our initial studies determined the free-energy barriers to ring flipping for each of the phenylalanine residues.

Acknowledgments: This project is supported by the NSF (CHE-1564349), XSEDE (CHE-140070), NERSC (m2495), the Camille and Henry Dreyfus Foundation (TH-14-028), and the Undergraduate Research Opportunity Program of the University of Colorado Denver.

## **Creating An Embryonic Stem Cell Line Expressing Green Fluorescent Protein Using CRISPR/Cas9**

**Student Authors:**

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**Faculty Mentor(s):**

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**Abstract:**

CRISPR (Clustered regularly interspaced short palindromic repeats) is one of the most revolutionary molecular biology techniques discovered in the past decade. Cas9, the protein that mediates CRISPR activity, binds to DNA by using a short guide RNA (gRNA) to find homologous DNA sequences, allowing Cas9 to make dsDNA breaks. One advantage of CRISPR allows for the insertion of exogenous DNA into the sites of dsDNA breaks. We chose to take advantage of this modification to insert GFP (green fluorescent protein) into the Rosa26 locus in mouse embryonic stem cells. The Rosa26 locus was selected for GFP insertion because other transgenes inserted at Rosa26 have high levels of constitutive

transgene expression. I will describe the details of how we have approached this exciting use of CRISPR/Cas9 technology.

## **The Enduring Reach of Japanese Fashion Design**

### **Student Authors:**

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### **Abstract:**

The enduring reach of 1980/1990 Japanese fashion design has long been examined as a period of explosive growth within the fashion world. However, its lasting effects on the contemporary fashion industry did not seem to last through the colorful 2000s. However, recent New York designers have started to gain inspiration for a new mode of fashion informing current street wear and avant garde styles. During the summer of 2017, my research lead me to video interview 3 designers about picking up from the past. They were all influenced by a period that championed artistry, oversized clothing, and new shapes of the body. I argue that previous Japanese fashion designers were well ahead of their time and have highly influenced contemporary styles. In conclusion, this project sheds light on the New York fashion scene and it's influx of young designers emulating 1980/1990 Japanese styles.

## **Use of the Oxford Nanopore MinION for Genome Sequencing of Environmental Samples**

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### **Faculty Mentor(s):**

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### **Abstract:**

Metagenomics uses DNA sequencing to study the genetic material collected from microbes living in their natural habitats. These microbes inhabit our everyday lives and make up an essential part of living systems. By being able to sequence DNA from these microbes, we can predict the function of these organisms. With current DNA sequencing technology, such as Illumina sequencing, short genomic reads from 150-300 base pairs long can be read, which are sampled from microbial genomes that are typically millions of base pairs long. Trying to find overlapping segments among these short reads makes it difficult to reassemble the individual genomes found in an environmental sample. A task made even

more challenging by the presence of many closely related genome sequences in an environment. The new Oxford Nanopore MinION sequencing machine generates very long reads, up to 1,000,000 base pairs long, but has decreased accuracy than shorter reads. Though these longer reads can be used in concordance with Illumina's short but accurate reads to stitch-together a more accurate genome. Long reads allow for easier overlap detection, and simpler assembly of microbial genomes from complex mixtures found in natural environments. We are applying this sequencing capability to microbial DNA from temperate freshwater wetland soils, which are a large source of microbially produced atmospheric methane. Initial Nanopore sequencing suggests these long reads and short Illumina reads are sampled from the same genomes. Future work to combine these datasets should improve genome assembly for the complex community of microbes that lives in these habitats.

## **Determining Granuphilin's Docking Mechanisms Through Mutation of a Membrane Binding Domain**

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### **Abstract:**

Insulin is a hormone that helps the body maintain its desired levels of glucose in the blood. Pancreatic  $\beta$ -cells contain a protein called granuphilin which helps dock insulin vesicles to the plasma membrane. Despite its function, more granuphilin in the cell results in a decrease of insulin secretion. The amino acid residues on granuphilin that are important for binding to the cell membrane were determined. This was done by mutating single amino acids (some mutations were at two or three residues) via site-directed mutagenesis and measuring the binding affinity through protein-lipid binding assays. The assay, fluorescence resonance energy transfer, is a technique that allows the binding or lack of binding of granuphilin to the cell membrane to be determined by difference in fluorescence peaks. Figuring out how to inhibit granuphilin through binding mechanisms could potentially serve as a way to increase insulin secretion.

# The Spatiotemporal Airway Pressure Distribution During Manual Jet Ventilation

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Dr. Daniel Fink

## Abstract:

Manual jet ventilation is commonly used in tracheal surgeries to provide gas exchange while maintaining an open tracheal lumen. Clinical practice currently dictates jet pressure selection by qualitative observation rather than quantitative values. Jet pressures, durations, and frequencies are determined based on the clinical experience of the anesthetist and the observed chest wall movement of the patient. This process can potentially lead to lung damage and poor gas exchange. The purpose of this research is to characterize airflow in the lungs during jet ventilation in order to prevent lung injury and provide optimal gas exchange. Experiments were conducted using a three dimensional (3D) physical reconstruction of the first five generations of the airway tree derived from computed tomography scans of a healthy teenage patient. Jet positioning and triggering were controlled using a modified 3D printer to allow precise and repeatable positioning of the jet nozzle at various depths and angles in the model trachea. Pressure sensors were inserted at points of interest along the distal airways and data was recorded and analyzed via custom data acquisition software written in MATLAB. The experimental measurements indicate that the position of the jet in the tracheal lumen strongly influences the regional pressure distribution in the distal airways. Large spatial variations in pressure were observed indicating that jet position plays an important role in maintaining ventilation homogeneity.

# Baby Bump: A content Analysis of Popular Women Magazines in English and Spanish

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**Abstract:**

Women's bodies are often scrutinized in negative ways based on cultural constructs of what the ideal body should be. Often these expectations are communicated through images and messages depicted in print media. Past research has focused on how women's bodies are portrayed in the media, how norms about the female body are communicated during pregnancy, when women experiences significant change in body size and shape, has not received as much attention. How these messages may vary across cultural contexts also deserves examination. For this research I analyzed popular online and printed copies of women magazines in two languages: English and Spanish to understand how stories and images about pregnancy represented pregnant women's bodies and to determine if there was variation between different language magazines. Data included 96 print and online magazine articles and images in English (49) and Spanish (47) collected from 06/01/2017-11/30/2017. Data were coded by categorizing images and articles into themes that included representation of bodies, birth control, pregnancy, and fertility. I found that among Spanish speaking magazines negative representations of body images were portrayed more than in English magazines, Spanish speaking magazines had no birth control information, and Spanish magazines. This information can give us an opportunity to understand how the media communicated body satisfaction during pregnancy through images and articles focused around pregnancy.

## **Computational Study of Olefin Metathesis Reactions with New Ruthenium Catalysts**

**Student Authors:**

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**Abstract:**

Ruthenium-based olefin metathesis catalysts have previously been shown to enable high E-selectivity. Density functional theory (DFT) calculations (B3LYP and M06) were performed to elucidate the mechanism of the ruthenium-catalyzed metathesis reactions. A variation of the Grubbs-type catalyst, 1cat, was used as a model. The high stereoselectivity was found to be a result of a four-membered metallocycle that forms between the ruthenium center and the olefin. Four different coordinations of the substrate to the metal center were considered, and of these the most energetically favorable conformations lead to the trans products.

## **Optimization of a human induced pluripotent stem cell derived cardiomyocyte differentiation method to increase reliability and efficiency for downstream applications**

### **Student Authors:**

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### **Faculty Mentor(s):**

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### **Abstract:**

Human induced pluripotent stem cells (hiPSCs) and their derived cardiomyocytes (hiPSC-CMs) are an important model currently used in tissue engineering, pharmacology, developmental biology, and genetic studies. With regard to tissue engineering, hiPSC-CMs can potentially be used to develop living patches to treat cardiac congenital birth defects, including Tetralogy of Fallot which affects 3-6 live births with a mortality rate of 50% for the first three years of life. Efficient cardiac differentiation involves small molecule activation of WNT signaling followed by inactivation of transforming growth factor  $\beta$  and WNT signaling with activation of sonic hedgehog signaling. Here, we attempt to improve cardiac differentiation efficiency from amniotic fluid-derived hiPSCs by fine tuning a robust protocol to achieve ~90% differentiation efficiency without subsequent purification of hiPSC-CMs. These homogenous hiPSC-CMs will be used in future studies to include investigation of the effect of porcine heart matrix (HM) on cell infiltration and migration into a poly(ethylene glycol)-fibrin (PEG-fibrin) biomaterial, cell maturation and contractility, and ultimately in-vivo studies in a murine model. This study, along with these future studies, is a vital step in the development of cardiac-like tissue to repair and regenerate a malformed or damaged heart.

## **Applying Optogenetics to Look at Ca<sup>2+</sup> Regulated Transcription Factor in Beta Cells**

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### **Abstract:**

Diabetes is a multi-faceted disease, having many adverse effects in the body due to dysfunction of insulin secreting beta cells in the pancreas. One of these effects is high blood glucose levels, which causes many chronic complications including blindness, cardiovascular and kidney disease, as well as risk

of hypoglycemia and death. Insulin secretion is required for lowering blood glucose. The transcription factor, nuclear factor of activated T-cell (NFAT), is thought to be involved in insulin granule formation and beta cell proliferation and development. Despite its importance for the pancreas and homeostasis of blood glucose, NFAT's exact mode of action is not well understood.

NFAT is regulated by an increase of intracellular  $\text{Ca}^{2+}$  levels. Upon increased blood glucose, a series of events lead to the activation of voltage gated  $\text{Ca}^{2+}$  channels. The cytosol is flooded with  $\text{Ca}^{2+}$  which initiates insulin secretion and NFAT activation. The purpose of this research is to utilize optogenetic management of  $\text{Ca}^{2+}$  levels in MIN6 cells to better understand how cells control NFAT translocation into the nucleus. To conduct this research,  $\text{Ca}^{2+}$  regulating membrane proteins were both stimulated and inhibited using light, cytokines and diazoxide. We hypothesize that cytokines greatly decrease  $\text{Ca}^{2+}$  fluctuation and that diazoxide completely halts it. Fluctuation of  $\text{Ca}^{2+}$  should be present when using blue light to stimulate the membrane cation channel—ChR2. The research that has been conducted supports this hypothesis. Implications of this data suggest that these forms of controlled  $\text{Ca}^{2+}$  fluctuation could be used to further study NFAT translocation.

## **Enhancing Electrogenic Conditions and Power Production in A Wastewater Microbial Fuel Cell**

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### **Abstract:**

Microbial fuel cells (MFCs) are an emerging form of sustainable energy that harvests electricity from sources of bacteria, such as wastewater. The chemical and biological conditions necessary to stabilize maximal power from MFCs are still being determined. This project aimed to set up MFCs with different chemical environments and characterize bacterial communities and power production associated with these environments. There are two microbially-active components to a wastewater MFC: (1) the anode and (2) the wastewater itself. To improve MFC electricity production, anodes were chemically modified using varying amounts of Polyaniline coating, a known conductive polymer. Modified anodes showed a 29% increase in capacitance compared to unmodified anodes. Successful anode modification was confirmed with fluorescence imaging. During operation, anode and wastewater samples were collected.

From each MFC for each timepoint, 16S rDNA sequencing was performed to identify members of the associated bacterial communities. Sequences were computationally analyzed using QIIME and R software to characterize and compare bacterial communities resulting from different anode modifications. Within 30 days of operation, an MFC with an unmodified anode produced 57 mV, whereas an MFC with a modified anode produced 239 mV. Given the differences in power production observed thus far, we expect to find different bacterial community activity and therefore different electrogenic potential. Continuing studies will identify conditions yielding optimal bacterial communities for increased power production in MFCs.

## **The Effect of Irrelevant Sounds on Eye Movements During Visual Search**

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### **Abstract:**

While it is well-established that current goals and visually salient events direct eye movements, the role that auditory stimuli play in the guidance of visual attention is less understood. The present study examined this crossmodal attentional behavior by tracking eye movements as participants complete a dynamic search task. Specifically, we further examined the “pip-and-pop” effect, a phenomenon wherein an uninformative sound that is synchronized with a target color change event leads participants to locate the target faster than when no sound accompanies the color change (Van der Burg, Olivers, Bronkhorst & Theeuwes, 2008). Our current study investigates how the nature of the auditory stimulus may modify this crossmodal effect, and also further examines the changes in eye movement patterns. Overall, the results indicate both faster reaction time and fewer fixations in search trials with sound events than trials with no sound. No significant difference in these measures was found between a simple, pure tone auditory stimulus and a more complex, frequency modulated auditory stimulus. This finding may suggest that the general presence of non-spatial sound in an environment affects the deployment of visual attention but that sound complexity does not further modulate this effect. Two additional experiments further manipulated the presentation of audiovisual events and participants' search strategy in an effort to produce a greater effect of sound presence. Such inquiry is important for building an understanding of how attentional behavior functions in response to the multisensory environments of the natural world.

## **Exploration of transition metal complexes with 8-oxo-7,8-dihydroguanosine as a potential probe for oxidative RNA lesions**

### **Student Authors:**

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**Abstract:**

8-oxo-7,8-dihydroguanosine (8-oxo-G) is arguably the most relevant lesion present in the RNA and DNA of biological systems exposed to oxidative stress. The altered chemical properties of 8-oxo-G, as compared to its canonical counterpart guanosine (G), allow for a variety of adverse genetic effects including mutagenesis and carcinogenesis. Certain transition metals have been documented to interact with DNA and RNA. However, little is known on the reactivity of transition metals with 8-oxo-G lesions. A large panel of reactions was used to assess the reactivity of various transition metal reagents with both G and 8-oxo-G nucleosides. Reactions of interest were analyzed via ultraviolet-visible light (UV-Vis) spectroscopy and nuclear magnetic resonance (NMR) spectroscopy. This study hopes to shed light on potential transition metal probes for 8-oxo-G lesions.

## **An Investigation of the Mechanism behind Calcium-Inhibited Membrane Binding by the C2A Domain of Synaptotagmin-Like Protein 2**

**Student Authors:**

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Abena Watson-Siriboe (UC Denver Department of Chemistry and Integrative Biology), Samuel Willstead (University of Southampton Department of Chemistry), Dr. Hai Lin (UC Denver Department of Chemistry), Dr. David Jones (UC Denver Anschutz Medical Campus Department of Pharmacology), Dr. Thomas Lee (UC Boulder Department of Chemistry and Biochemistry).

**Abstract:**

C2 domains are a key component of membrane-trafficking proteins involved in a variety of cellular processes such as exocytosis, the release of chemicals from inside the cell to the extracellular environment. C2 domains may exhibit membrane-binding activity that is normally classified into two categories: Ca<sup>2+</sup>-dependent or Ca<sup>2+</sup>-independent. There is a C2 domain however, the C2A domain of synaptotagmin-like protein 2 (SLP2C2A) that exhibits a third method of membrane binding: Ca<sup>2+</sup>-inhibited. This study of SLP2C2A set out to identify the mechanism behind its Ca<sup>2+</sup>-inhibited membrane binding exhibited in vitro. In this study, the C2A domain of SLP2 was expressed, purified, and shown to dissociate from membranes with the addition of Ca<sup>2+</sup>. Data obtained using established Trp-Dansyl fluorescence-based assays suggest the concentration of Ca<sup>2+</sup> required to dissociate half of SLP2C2A from a bound membrane (the IC<sub>50</sub> value) is approximately 20-fold higher than previously reported and well above physiological levels. Two models were tested in an attempt to probe the nature of this Ca<sup>2+</sup>-

inhibited membrane binding. In the protein-centric model, Ca<sup>2+</sup> binds SLP2C2A in an allosteric manner and inhibits membrane binding. In the lipid-centric model, Ca<sup>2+</sup> coordinates anionic lipids and competes with SLP2C2A for membrane binding. Although 15N1H NMR data and novel Be<sup>2+</sup>-dansyl assays backed the lipid-centric model, results did not support either model in full; this suggests a more complex mechanism that combines aspects of both models may be responsible.

## **Equity in the Pre-health Application Cycle: an Analysis of Two Financial Assistance Programs**

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Mrs. Trishia Vasquez, B.S., Health Professions Programs; Dr. Laura M. Argys, Ph.D., Department of Economics

### **Abstract:**

Two programs offset the costs of applying to medical and dental schools: National Fee Assistance Programs (FAPs) provide funds towards entrance exam and application fees for low-income pre-medical/pre-dental applicants; the Bardwell Donachy Family Opportunity Fund (B-D Fund), a CU Denver program, provides funds for interview expenses to committed, diverse and low-income pre-medical/pre-dental applicants invited to interview. We conducted a mixed-methodology study consisting of a survey administered to CU Denver pre-medical/pre-dental students (n = 68) and one-on-one semi-structured interviews with CU Denver pre-medical/pre-dental applicants (n = 15) to evaluate the effectiveness of FAP and the B-D Fund on improving the success and opportunities of pre-medical/pre-dental applicants. Outcome measures included the number of schools one applied to, number of interviews attended and support of underrepresented students in medicine (UIM) (i.e. racial/ethnic minority, first generation student, etc). We found no significant difference in the number of MD/DO schools one applied to between applicants who received FAP and applicants who did not receive FAP; no pre-dental applicants received FAP. After controlling for overall grade point average, Medical College Admission Test score and the number of MD/DO schools one applied to, receiving the B-D Fund was associated with attending two more interviews, on average, compared to non-recipients. Of the 21 B-D Fund recipients, 14 were classified as UIM. Both the FAP and B-D Fund were effective in aiding pre-medical and UIM applicants in the application process, but more data is required to assess the effectiveness of these programs for pre-dental students.

## **Inner/Outer Worlds: Yan Liben's (ca. 600 - 673 CE) "Foreign Envoy with Tribute Bearers" (7th century CE) painting and the Function of Depicted Rock Tributes during Tang Dynasty (618 – 907 CE) China**

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### **Abstract:**

Yan Liben's (ca. 600 - 673 CE) Foreign Envoy with Tribute Bearers (7th century CE) painting is analyzed with a discussion and exploration of the meaning of rock tributes in the painting, rocks in the Chinese garden, and the importance of the tribute system within the Tang Dynasty (618 – 907 CE). Previous accounts record the meaning of giving land and treasures of native countries to China. Gifts and the tribute bearer genre represent China's desire to expand and develop into foreign nations and its belief in its superiority as the center of the world. This worldview, is condensed into the Chinese garden worldview, which didn't have boundaries but was defined by interactions between the hierarchies of the inner world/center (China and the throne) and the outer world/peripheral (non-Chinese peoples); everything stemmed from and towards the Chinese center. This paper gives insights into the complex interaction and relationship between China and its trading partners via the tribute system depicted on the painting, and how the depicted rock tributes reinforce and realize the Chinese worldview.

## **Comparison of Digital and Visual Estimations of Vegetation Cover for Ecological Research**

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**Abstract:**

Percent ground covered by vegetation is an important ecological variable, but different methods of estimating vegetation cover must be compared for effectiveness. We developed an Adobe Photoshop CC method to determine vegetation and deadfall (fallen tree) cover from field photographs and compared digital estimates to standard visual estimates. We applied both methods to a long-term, post-fire forest regeneration study at Henderson Mtn, Custer Gallatin National Forest, and Mt. Washburn, Yellowstone National Park. Areas included moist burned (MB) and dry burned (DB) sites and unburned (MU and DU) controls; 258 plots were re-measured in 2016 and 2017. We photographed plots from the north and south holding a Go-PRO camera overhead on a selfie-stick. Total pixels, green pixels (vegetation), and brown pixels (deadfall) were extracted from photos to calculate percent vegetation and deadfall cover. Using the Wilcoxon rank sum test, we compared the two methods' percent vegetation and deadfall cover. Thus far, Henderson Mountain digital vegetation cover estimates ranged from 32-77% (DB), 41-96% (MU), 37-91% (MB) and 29-93% (DU). Henderson Mountain's visual estimates ranged from 30-65% (DB), 40-85% (MU), 35-85% (MB) and 30-80% (DU). Mt. Washburn's digital vegetation cover estimates ranged from 11-65% (DB), 3-76% (MB) and 10-67% (MU). Mt. Washburn's visual vegetation cover estimates ranged from 40-75% (DB) and 25-80% (MB). Statistical tests indicated significant ( $p < 0.05$ ) differences between estimation methods in all treatments except Henderson Mtn.'s unburned plots, which had little deadfall. Results indicate visual estimates may better detect deadfall-hidden vegetation, but photos may better estimate deadfall cover.

## **A Graphical User Interface to Aid in the Analysis of Arteriole Stiffening in Patients Using Continuous-Flow Left Ventricular Assist Devices**

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Dr. Amrut Ambardekar

**Abstract:**

The objective of my research is a continuation of the research begun by Ambardekar, Hunter, et al. in the examination of morphology, composition, and stiffness of arterial vasculature in patients with continuous-flow LVADs. At this time over 100 mechanical studies have been performed; with this new, substantially larger dataset in mind, I have created a graphical interface to be used in the analysis of the acquired data.

The analysis is performed in MATLAB by storing strain data from each disease state in its own vector. A curve is fit to the stored data and the user has the opportunity to accept/reject specific data sets. A mean is obtained by summing all data for each test and disease state and dividing by the number of samples. Standard error bars are calculated through variance. These group studies determine if LVAD

implantation has an effect on Aortic remodeling and stiffness. Finally, regressions can be performed with independent variables being stiffness, thickness, and other histological factors with the predictors, or dependent variables being patient LV function prior to LVAD implant (or overall transplant), to assess if these factors are disease related rather than LVAD related.