

Exploring the Food Environment and Food Related Behavior in Skagway, Alaska (Full Grant)

Lindsay C. Adams, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jean Scandlyn, Health and Behavioral Sciences, DC - College of Liberal Arts and Sciences

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 semi-structured 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.

Evaluation of honey bee health, honey production, and hive maintenance in Flow™ hives and traditional Langstroth hives (Full Grant)

Kade G Beem, Geography
DC - College of Liberal Arts and Sciences

Vy Nguyen, Biology
DC - College of Liberal Arts and Sciences

Joseph Primm, Geography
DC - College of Liberal Arts and Sciences

Mentor: Dr. Christy Briles, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:

Honeybees (*Apis mellifera*) are essential pollinators for plants that make up approximately one-third of the global food supply. Currently, honeybees are declining globally due to insecticides, parasites, and harmful pathogens. Many new bee products have hit the market claiming improved honeybee health and easier beekeeping, including Flow™ frames. Flow™ raised 12 million dollars in 2015, with no research to back their claims. Our study tested the Flow™ frames alongside traditional Langstroth frames (10 hives each) to determine if the Flow™ frames were 1) better for the bees 2) easier on the beekeeper, and 3) produced more honey. We examined pollen, honey production, parasitic mite counts, and bee microbiomes (sequencing in progress). The Flow™ frames took more time to construct, did not produce as much honey, and Fall honey did not flow from the frames as advertised. The bees sourced similar types of pollen; however, traditional hives brought in more *Tilia* and *Plantago*, indicating that Flow™ frames may result in different food collection. Flow™ frames contained a total of 86 mites, while there were 148 in traditional frames. Total honey harvested was approximately 50% more in traditional frames than Flow™ frames. Six Flow™ and four traditional hives survived through winter. The Flow™ hives experienced less mortality, likely due to bees building up the brood box rather than filling out the Flow™ frames. The study provides information on suburban bee populations along the Colorado Front Range and baseline data for future research on honeybee foraging patterns and health.

2016/2017 ARCH 3600 International Design Build (Mini Grant)

Alexander K Bender, Architecture
DC - College of Architecture and Planning

Will Oliver, Architecture (Mini Grant Recipient)
DC – College of Architecture and Planning

Mentor: Ms. Jo Vandenburg, Architecture, DC - College of Architecture and Planning

Abstract:

Through the fall semester of 2016 and interim of 2016, students in the College of Architecture and Planning actively engaged in the design and construction of a community center in the Jalapa Valley of Nicaragua. The fall course focused on establishing: the context of site conditions, investigating current and past issues of culture, politics, environment, building resources, and health and education within Nicaragua. This research helped to inform the design and planning of the community center. Lastly, the students partnered with the non-profit organization Friendship City Projects fundraise \$12,000 for construction cost and materials. The winterium portion of the course focused on construction and documentation. Students traveled to Nicaragua to spend 10 full days on site constructing the design developed in the fall course. Students learned firsthand about thinking critically in a real-world construction environment that was relevant to local Nicaraguan cultural context. Lastly, the construction process was documented by mixing different medias such as sketching and digital drawings. We look forward to sharing our experiences with you.

What About the Children (Mini Grant)

Vanessa Buck, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Esther Sullivan, Sociology, DC - College of Liberal Arts and Sciences

Abstract:

Within the Northeast Denver area there lies the neighborhood of Swansea; however, it remains unknown to most due to its out-of-sight location under the I-70 highway. Swansea is currently facing many inequalities that are affecting the quality of life for its residents; one such inequality is the lack of high-quality walkways. Although this inequality affects everyone within the neighborhood, children that attend Swansea Elementary are severely affected. This research study investigates Swansea's walkway sites and conditions while also examining how the children's safety is affected by these poor conditions. In depth interviews with four families of Swansea Elementary are incorporated with video footage of the walkways to create a digital ethnography that portrays the families concerns and suggestions while the viewer is able to experience a walk through Swansea in the children's shoes. The purpose of this research study is to investigate and report on the need for improved walkways in Swansea. While the City of Denver has plans to expand the I-70 highway, a construction that will displace 40 homes in Swansea, it is important for the city to recognize other projects that could improve the quality of life for the residents within Swansea, and in this case, especially the children.

Characterizing Motivational Changes Resulting from Distinct Behavioral Histories of Sucrose Access (Full Grant – CCTSI)

Nihal A. Eltom, Biology, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Erik B. Oleson, Psychology, DC - College of Liberal Arts and Sciences

Abstract:

Approximately 2/3 of adults in the United States are either overweight or obese. Studies have shown that on average, Americans consume about 500-800 more calories per day than needed because of the availability of food, more specifically, carbohydrate rich and sucrose enriched foods (Flegal et al, 2000). Characterizing the effects of sucrose access on motivational and neurochemical markers of addiction may help to elucidate the neural basis of obesity. In the present study we are providing rats with either no access, intermittent access or unlimited access to sucrose in their home operant boxes in 23hr cycles over 28 days. Over the 28-day history, we assess for overall and circadian changes in: food intake, sucrose intake, water intake and weight gain. We then use a novel behavioral economic food seeking task and the progressive ratio schedule to assess for changes in motivation for sucrose.

Simulating the Islet: Exploring Diabetes Predisposition with Computer Modeling (Full Grant)

William L. Fischer, Mathematics (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Richard Benninger, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:

In the past 35 years, the number of diabetic patients in the United States has increased almost six fold. Unfortunately, it's not a simple condition with a single cause. Instead, diabetes refers to a family of metabolic conditions that prevent the body from correctly regulating glucose levels. Without proper treatment, this can be debilitating or deadly. Understanding diabetes, however, is as difficult as it is essential. Glucose metabolism is regulated by a vast network of anatomical systems, so there are countless abnormalities that might predispose someone to the disease. For example, in the pancreatic Islets of Langerhans, when glucose is detected by clusters of interconnected Beta-cells, a cascading signal pathway triggers the coordinated secretion of insulin. Mutations in genes that encode the many proteins involved in this signal pathway can impact the insulin response. Mutations for multiple proteins in one patient could have a cumulative effect, which could significantly increase the patient's risk of diabetes. This project used computer modeling to simulate Beta-cell insulin responses to glucose stimulation under various combinations of possible defects. The model uses numerical approximation methods to solve a series of differential equations representing a simplified signaling pathway in the Beta-cell network. The study focuses on finding peaks in insulin secretion impact when multiple defects occur simultaneously. This approach can help us determine if specific combinations of mutations may be overly detrimental to Islet function, or contribute more to the progression of the disease, which in turn could inform strategies to treat islet dysfunction and diabetes.

Development of a Near-Infrared Optical Coherence Tomographic Microscope for Use in the Imaging of Neural Tissues (Full Grant)

Thomas Fox, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Andrew Challinor, Bioengineering
DC - College Engineering and Applied Sciences

Mentor: Dr. Emily Gibson, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:

Optical Coherence Tomography (OCT) uses a series of two-dimensional tomographic images to produce a three-dimensional image of an object. OCT is based on the Michelson Interferometer, which uses the principles of optical superposition to resolve microscopic distances. This technology has found limited applications within the realm of neural imaging and surgical navigation. A near-infrared (850 nanometers) fiber-optic OCT microscope was developed to investigate its ability to produce resolvable images of neural tissues. Given by the properties of the LED diode, the microscope is capable of a depth resolution of 6.2 micrometers and a depth of field of 14 micrometers. Additionally, a virtual instrument was developed in LabVIEW to control the microscope electronically.

Synthesis of functionalized oligonucleotides of RNA using 2-methylbenzothiophenyl groups at the C2'-O- position of uridine and adenosine (Full Grant)

Andrew J Francis, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Kokouvi Y. Dzowo, Modern Human Anatomy, School of Medicine
AMC - Graduate School

Mentor: Dr. Marino J. E. Resendiz, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Given the significant role that RNA plays in many cellular processes, methodologies to functionalize this biopolymer have shown potential uses in medical therapies. Our goal is to functionalize oligonucleotides of RNA at the C2'-O- position using photoactive groups ($\lambda_{\text{max}} > 290 \text{ nm}$) and utilize this reactivity to alter their structure reversibly. Adenosine and Uridine were functionalized with 2-methyl-benzothiophenyl units for our initial studies. The first step in the synthesis of the probe was to produce 2-hydroxymethyl benzothiophene, obtained by reacting benzothiophene with paraformaldehyde after deprotonation with n-butyl lithium. This alcohol was brominated by reacting with carbon tetrabromide in the presence of triphenyl phosphine to yield the corresponding 2-bromomethylbenzothiophene group (70%). Functionalization at the C2'-O- was achieved via selective protection of the C3'- and C5'- position using 1,1,3,3-tetraisopropyl-1,3-dichlorodisiloxane and allowing its exclusive functionalization at the C2'-O- position (75%). Desilylation was achieved using hydrogen fluoride and resulted in the C2'-O- functionalized nucleoside in quantitative yields. Current focus is being placed on the synthesis of the corresponding phosphoramidites for their incorporation into oligonucleotides of RNA. In addition to this effort, electronic structure calculations that compares modified RNA duplexes to its canonical analogue using density function theory was also used to compare the stabilizing effect of RNA duplex modified with four 2-thiophenyl methyl functional groups on each strand. This simulation displayed a greater stabilization effect on the modified RNA duplexes compared to its canonical analogue. This type of modeling will guide our efforts in developing synthetic methodology.

Investigating Roles for FTO and Gsk-3 in Stem Cell Pluripotency (Full Grant – CCTSI)

Sanju Garimella, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Christopher Phiel, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

Glycogen synthase kinase-3 (GSK-3) is a protein kinase involved in many intracellular regulatory events. A novel role for GSK-3 was recently discovered by our lab – the regulation of mRNA methylation, referred to as m6A (methylation of adenosine bases at the C6 position). The m6A modification of mRNA is believed to control the stability of mRNA, and thus the persistence of gene expression. We have found evidence that GSK-3 controls m6A levels by regulating the enzyme that demethylates mRNA, FTO. In this study, a FTO lentivirus was made and wild type mouse embryonic stem cells (WT mESC's) were infected to create a stable cell line with FTO over-expression. A stable cell line has also been created using WT S33A cells, a cell line with a point mutation on serine 33 to adenine in the beta-catenin pathway. Progress on these studies will be presented in the report.

Dopamine Release in the Medial Dorsal Striatum During Voluntary Exercise (Full Grant and Mini Grant)

Glen Gillan, Psychology (UROP Recipient - Full)

Natalie M. Haddad, Chemistry (UROP Recipient – Full and Mini)

Scott Schelp

Katherine Pultorak

DC - College of Liberal Arts and Sciences

Mentors: Dr. Benjamin Greenwood, Psychology, DC - College of Liberal Arts and Sciences

Dr. Erik B. Oleson – College of Liberal Arts and Sciences

Abstract:

Despite the clear health benefits of physical activity, the participation in exercise by the general public is in constant decline. Identifying factors contributing to motivation to participate in exercise could have dramatic effects on quality of life. The neurotransmitter dopamine has been shown to play a crucial role in movement, reinforcement, and goal-directed behavior. There are two well-characterized patterns of dopamine release: tonic and phasic. Tonic is characterized by spontaneously occurring baseline release, and phasic by high-frequency, burst-firing which can drastically increase dopamine efflux. Indeed, phasic DA increases signaling through low-affinity dopamine 1 receptors thought to be particularly important for reinforcement and the promotion of movement. There is a general assumption that physical activity increases dopamine concentrations in target brain areas that promote reinforcement and movement, however the effect of voluntary exercise on phasic dopamine release has not been investigated. We characterized phasic dopamine release events in rats during voluntary wheel running using fast-scan cyclic voltammetry. Phasic dopamine release was measured in the dorsal striatum before, during, and after an acute voluntary wheel running bout, in rats with a history of between 1 and 3 weeks of prior nightly exercise. Data indicates that phasic DA release in the DMS increases during a running bout. As exercise behavior becomes habitual, the DA concentration decreases but the frequency of release events remains elevated. These data represent the first characterization of phasic dopamine release events during spontaneous, voluntary exercise, and could provide novel insight into the role of dopamine in guiding motivated behavior

Using FRET and Lipid Coated Gold Nanoparticles to Monitor Synaptotagmin 7 C2A Facilitated Liposome Apposition (Full Grant)

Desmond J Hamilton, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jeff D. Knight, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Synaptotagmin (Syt) proteins are composed of tandem C2A and C2B domains that mediate exocytosis by binding to anionic membranes when cytosolic Ca^{2+} concentrations increase in neuronal and endocrinal cells. Syt1- and Syt7-C2A domains have distinct differences in anionic lipid binding affinities, yet the biological consequences of this remain unanswered. For example, Syt7 C2A's capacity to trigger membrane apposition and liposome clustering was previously unknown. Here, we show that Syt7 C2A can initiate membrane apposition and liposome clustering with the localized surface plasmon resonance (LSPR) of lipid-coated gold nanoparticles (LCAuNP), Förster resonance energy transfer (FRET) assays, and dynamic light scattering. Markedly, changes in the LSPR of LCAuNPs were observed with only 9.3 nM Syt7 C2A. Furthermore, of the three sizes investigated, 40, 55, and 77-nm diameter LCAuNPs, the 77-nm had the fastest rate constant for Syt7 C2A mediated clustering. Protein-membrane and inter-liposome FRET assays were used to demonstrate distinct Ca^{2+} and Syt7 C2A concentration dependent events: Syt7 C2A binding, then liposome apposition, followed by aggregation. A liposome competition FRET assay showed that Syt7 C2A remains bound to anionic membranes in the presence of 100 μM Ca^{2+} , indicating high membrane binding affinity. LCAuNPs were added to the inter-liposome FRET assay inducing a 2-fold increase in FRET due to nanoparticle enhanced energy transfer (NEET). As a whole, LCAuNP biosensors act as highly sensitive detectors that can report on protein-mediated apposition events prior to large-scale aggregation. Finally, energy transfer through LCAuNPs with NEET may allow for deeper investigations into the dynamics of bio-molecular systems.

Determining the Enzymatic Degradation of RNA Containing 8-oxo-7,8 dihydroguanine (Mini Grant)

Cassandra C. Herbert, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Marino J. E. Resendiz, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

The focus of this study relies on the use of ribonucleases to assess local and global changes in RNA structure due to the oxidative lesion, 8-oxo-7,8 dihydroguanine (8-oxoG). Strands of RNA containing 8-oxoG were comparatively analyzed to determine changes in enzymatic degradation. Analysis of enzymatic degradation was accomplished via electrophoretic analysis (PAGE). The ribonucleases used in this study are RNase T1 and RNase A. Due to the conformational change at 8-oxo-G sites and the H-bonding pattern that is equivalent to those expected from pyrimidine containing nucleobases, data confirms that 8-oxoG is a substrate for RNase A and not a substrate for RNase T1

The Oxytocin Receptor Gene and Posttraumatic Growth Modulate the Effects of Stress on Prosocial Behavior (Mini Grant)

Robert Jirsaraie, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. David S. Albeck, Psychology, DC - College of Liberal Arts and Sciences

Abstract:

Previous research that has analyzed the effects of stress on prosocial behavior (actions that are intended to benefit others) have reported mixed results. Some studies suggest that stress increases prosocial behaviors, while others suggest that stress decreases them. These inconsistencies may result from unexplored factors that modulate the relationship between stress and prosocial behavior. For instance, some studies did not measure the oxytocin receptor (OXTR) gene subtype, which is strongly associated with prosocial behaviors, while other studies have not considered the positive outcomes of stressful experiences, such as post-traumatic growth. This study is designed to account for all these variables by investigating how environmental stress, post-traumatic growth, and the OXTR gene subtype interact to influence prosocial behaviors, such as cooperation and charitability. The collected data is currently being analyzed, and will be ready for presentation by the time of the symposium. The purpose of this study is to identify factors that modulate the effects of stress, and determine the specific conditions when stress enhances and inhibits prosocial behaviors.

Historical Occurrence of Intersex in Fishes (Mini Grant)

Harmanpreet K. Kang, Biology
DC - College of Liberal Arts and Sciences

Marian Evans, Psychology – Mini Grant Recipient
DC - College of Liberal Arts and Sciences

Daniel Bor, Biology
DC - College of Liberal Arts and Sciences

Brigitte Nguyen, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Dr. Alan M. Vajda, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

The primary objective of this project is 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. We have secured access to several museum collections of these species sampled approximately 25, 50, and 100 years ago. The collected 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 on reproduction is an innovative approach to address an emerging eco-human health issue, and has broad transferability for the evaluation of contaminant trends in diverse populations, globally.

Self-illuminating Nanoparticles for optical imaging (Full Grant – CCTSI)

Rupinder Kaur, Chemistry, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jung-Jae Lee, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Molecular imaging is a fast growing field utilizing molecular probes that emit signals from the site of probes' localization and activation. Molecular imaging is amenable to the early identification of disease, facile monitoring of treatment, and acceleration of drug discovery. Fluorescent probes and labels have been of great importance in optical imaging but shown an obvious limitation of restricted tissue penetration for in vivo optical imaging. However, dyes emitting near-infrared (NIR) radiation with wavelengths in the region of 650-900 nm have a distinct sensitivity advantage due to diminished Raman scattering and low background of autofluorescence. Luminescent sensors provide an advantage of deeper tissue penetration with a high optimal target background ratio. We have recently discovered a unique set of NIR dyes that emit both chemiluminescent and fluorescent, and we have fabricated nanoparticles for dual modality optical imaging. The chemiluminescence is thermally-activated (that is, no chemical or electrical stimulus is needed) which means that the nanoparticles can be stored at low temperature (< 4 oC) and they only become chemiluminescent when warmed to body temperature. Preliminary results in mice show that chemiluminescence imaging permits identification of target sites that are more than two centimeters below the animal surface, which is about five times deeper than currently achieved using planar fluorescence imaging. A new imaging paradigm with self-illuminating nanoparticles including chemiluminescent and fluorescent will be demonstrated with experiments using relatively deep-tissue orthotopic and spontaneous tumor models in rodents.

Rock Art Stability in Grenada (Full Grant)

Cayla D. Kennedy, Geography (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr Casey D Allen, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:

During Dr. Casey Allen's Maymester 2015 field study program "Sustainability in the Caribbean", certain heritage sites, locally named "Carib Stones," were documented thoroughly and assessed for their geologic stability using the Rock Art Stability Index (RASI), a non-invasive rapid assessment that evaluates over three dozen rock decay variables. Prior to assessment, a group of well-meaning volunteers cleaned and potentially damaged one of the 1000-year-old petroglyph (rock art) sites. Two sites (Mount Rich and Duquesne Bay) had been assessed in previous years using RASI. While on-island in 2015, two additional sites (Victoria and Waltham) were discovered and preliminarily assessed for stability, but their precarious locations necessitated further study. Reassessments of the Victoria and Waltham sites in 2016 showed both sites in stable condition, but the setting around each of the sites caused some concern for the future of the Carib Stones. At the Victoria site, the boulder with petroglyphs is situated just below the major ring road, in a storm drain on the beach, and has previously been used as a trash dumping site. The Waltham site contains two boulders with numerous fading petroglyphs, and both sites are located on private property, near to the ocean and an ephemeral stream, and within reach of pets, people, and livestock. For each of these, the concerns listed may cause an acceleration in decay that may not occur if the petroglyphs were protected. This research highlights such concerns and lays the baseline for future geologic assessments for the Victoria and Waltham sites.

Role of 2-Arachidonoylglycerol on Aggressive Behavior and Medial Prefrontal Cortex Function in Male or Female Rats (Mini Grant)

Tassawwar A. Khan, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Sondra T. Bland, Psychology , DC - College of Liberal Arts and Sciences

Abstract:

Normal social experiences early in life are critical for the development of healthy social function. Rats that experience social isolation during adolescence are observed to have aggressive behaviors, providing an animal model of early social adversity. In this experiment, the drug MJN110 was used to determine whether increasing the endocannabinoid 2-AG would reduce the aggressive behavior of isolated rats. The mPFC (medial prefrontal cortex) was studied as it regulates social behaviors. MJN110 is a MAGL (Monoacylglycerol Lipase) inhibitor, which inhibits the breakdown of 2AG. Male and female rats were assigned to group housing or isolation for 4 weeks, then received either vehicle or one of two different doses of MJN110. Then, half of the rats had a single 10-minute trial of social interaction with a novel stimulus rat while the other remained in their cages. MJN110 the aggressive behaviors of the socially isolated rats but had no effect on non-aggressive social interaction. Next, analysis of the mPFC took place with observations of glial and neuronal cell expressions for p-MTOR (phosphorylated mammalian target of rapamycin) pathway, which is a marker for neuronal plasticity. However, the results indicated that there was no relation between MJN110 administration and its subsequent behavioral changes with neuronal and glial cell expression in the mPFC, as no effect of MJN110 was observed on p-mTOR in the mPFC.

CRISPR vs. VODKA: Tagging GFP to an Endogenous Protein in Yeast Using CRISPR-Cas9. A system to quantitatively study genetic expression. (Mini Grant)

Abraheem F. Khouqeer, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Douglas Shepherd, Physics, DC - College of Liberal Arts and Sciences

Abstract:

Studies of in vivo gene expression have undergone fundamental changes with the rapid emergence of quantitative imaging methods. Using fluorescent molecules, components of the genetic expression mechanism, such as RNA and proteins, can be quantified using microscopy. In this study, a CRISPR-Cas9 system was developed to edit the HOG1 gene expressing an endogenous protein, mitogen-activated protein kinase (MAPK), in yeast. MAPK allows yeast to respond to osmotic stress, such as changes in salt concentration. Previous studies have examined the RNA expression of HOG1 in response to changes in salt concentration. In this study, we aim to construct a CRISPR-Cas9 methodology to study the protein expression of HOG1 itself. The CRISPR-Cas9 system is designed to introduce a green fluorescent protein (GFP) genetic sequence to the HOG1 gene, where the expressed MAPK is tagged with GFP. This allows for the study of the endogenous protein dynamics in response to changes in salt concentration

Pulmonary Vascular Input Impedance as a Predictor of Disease Progression in Pediatric Pulmonary Hypertension (Mini Grant)

Aimee Lam, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Kendall S. Hunter, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:

Pulmonary Hypertension (PH) is a disease of the lungs which yields increased blood pressure in the pulmonary circulation and stress on the right side of the heart. The pulmonary vascular input impedance (Z), developed at Children's Hospital Colorado, has been utilized to obtain more information regarding the disease, including pulmonary vascular stiffness (PVS) as well as providing more insight into frequency-dependent pulmonary vascular resistance (PVR). Because earlier studies included very small populations to conduct disease prognosis analyses, this study addresses this limitation by substantially increasing the population size – thus allowing us to assess the usability of impedance in the prediction of disease outcomes. Here, outcomes analysis is employed to evaluate the change of disease progression of pulmonary hypertension in pediatric patients. In addition, descriptive statistics are employed to describe whether PVR and Z easily differentiate between healthy and ill children, as well as to determine if a relationship exists between PVR and Z . In an era where many studies are not validated – and indeed, many are later disproven – this study is novel in that it provides an opportunity to expand the current database for consideration of a wider range of patients while validating the data. The prediction of disease will undoubtedly change between different population sizes, and so analyzing impedance as a predictor in this larger population will enable one to understand impedance and the capabilities it possesses.

Rapamycin Modulates Exercise Induced Increases in mTOR without Affecting Fear Extinction Learning or Wheel Running Behavior (Full Grant)

Brian A Lloyd, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Holly Hake, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Margaret Tanner, Biology
DC - College of Liberal Arts and Sciences

Caroline Farmer, Biology
DC - College of Liberal Arts and Sciences

Mykola Ostrovskyy, Biology
DC - College of Liberal Arts and Sciences

Tammy Nguyen, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Benjamin N. Greenwood, Psychology, DC - College of Liberal Arts and Sciences

Abstract:

Exercise is well known to produce beneficial effects in cognition and mental health including enhancing memory and providing resistance against stress-related anxiety disorders. In rats, these effects have shown to include enhancing fear extinction memory wherein exercising after exposure-based fear extinction training reduced fear and fear relapse. The mechanisms by which these beneficial effects occur is unknown. The mammalian target of rapamycin (mTOR) is a signaling protein involved in synaptic plasticity, cell growth, and cell survival. mTOR signaling has been shown to be increased in brain areas involved in learning and emotional behavior after exercise and is therefore a compelling candidate for

providing the cognitive benefits of exercise. The goal of the present study was to test the hypothesis that mTOR signaling is required for the beneficial effect of exercise to enhance fear extinction memory. To test this hypothesis, the mTOR inhibitor, rapamycin was injected systemically to block mTOR signaling. Results show that rapamycin did not inhibit wheel running behavior and did not impair fear extinction learning. Assessment of whether rapamycin blocks the increased expression of a downstream protein, pS6, after exercise is ongoing. These results provide evidence that rapamycin is an mTOR inhibitor that could be used to study the cognitive effects of exercise given that it does not impair running behavior or extinction learning.

A Simple Isomerization Investigation as a Teaching Tool in Advanced Undergraduate Organic Chemistry Laboratories (Mini Grant)

Chelsi N Lopez, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Vanessa Fishback, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

A simple synthetic protocol was adapted for use in Honors Organic Chemistry Laboratories for undergraduates at the CU Denver as a teaching tool for common organic themes as well as more advanced characterization and analysis topics. The reaction performed by students is a first-hand example of nucleophilic attack both intermolecularly and intramolecularly, a vital mechanistic theme that appears often in undergraduate organic chemistry. By analyzing their final products, students obtain advanced spectroscopic experience, as the proton nuclear magnetic resonance (^1H NMR) analysis comprises common topics such as electron deshielding, splitting patterns, coupling constants, as well as providing exposure to higher-level NMR analysis due to ring-chair conformations and diastereotopicity of the final products. The results also require an in-depth analysis by constructing representative resonance states and deducing their impact on the reactivity of specific functional groups. The results obtained from a preliminary cohort of 20 students assigned to various starting material provided linear data from which students could directly relate their developed hypothesis to the obtained results. A second cohort performed the experiment with only two types of starting material, comparing their results with the previous cohort and determining whether their results were analogous.

Community Health Needs Assessment of Denver's Refugee Population (Mini Grant)

Damarcus McGill, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Savita Malik, Health and Behavioral Sciences, DC - College of Liberal Arts and Sciences

Abstract:

According to Denver's Office of Immigrant and Refugee Affairs, 1,797 refugees were resettled in Colorado during 2012 and this figure has looked similar in subsequent years. Most of these refugees are resettled in the Denver-metro area. Persecution and torture based on religious, political or other beliefs and identities as well as the resettlement process itself can cause negative health outcomes. These outcomes include post-traumatic stress disorder and chronic diseases from food insecurity. After the resettlement process, navigating the American healthcare system and adjusting to society can worsen existing health issues or contribute to the development of new illnesses. A health needs assessment can be conducted to examine these issues and then be used to make recommendations that improve health outcomes.

To What Extent Do Intercolonial Pavement Ants' Interactions Change at Different Increments of Time of Isolation? (Mini Grant)

Brigitte Nguyen, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Michael Greene, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

Pavement ants are common urban ants that form conspicuous wars between neighboring colonies. In these wars, ants from two colonies fight in a ritualized manner by biting body parts and engaging in a "push-of-war". We use the pavement ant as a model to study the collective-organization of aggression between competing societies. Ant colonies are collectively organized in distributed systems, in which, ants regulate behavior without the use of a hierarchical authority. Instead ants make behavioral decisions using information from detective cues. These chemical cues help identify colony membership and lead to collective-decisions by the colony. Interaction patterns inform ant decisions. Interactions among nestmates and non-nestmates occur when ants touch antennae to another's body. Pavement ants are more likely to fight a non-nestmate ant if they have had a recent history of interaction with nestmate ants. Interaction rates of pavement ants collected from ant colonies on the Auraria campus will be measured and observed. Ants will be separated into 10 groups of 10 ants and then isolated individually, in clear plastic vials, for different increments of time, ranging from 10 minutes to 80 minutes, with a control group of no isolation. Ants will then be placed in an arena for 10 minutes. The interactions will be tracked and analyzed via computer program called Ant Tracks. This program allows for the labeling of individual ants and the tracking of ant interaction. This poster will present preliminary data. The project began in March 2017 and awarded by UROP in April 2017.

SNP-Based Pathway Enrichment Analysis of Genetic Datasets to Determine a Link Between Bipolar Disorder and Allergies (Full Grant)

Sierra S. Niemiec, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Stephanie A. Santorico, Mathematical and Statistical Sciences, DC - College of Liberal Arts and Sciences

Abstract:

Bipolar disorder (BD) is a brain disorder characterized by extreme shifts in mood, cognition, energy, and ability to function in society. BD can affect school and work performance, damage relationships, and lead to suicide. Based on a paper by Kleinman and colleagues (2003), annual costs for the care and treatment of BD-affected individuals were estimated at \$45.2 billion. Despite the high costs, the distinct underpinnings of this illness are not yet fully understood. Studies by Baumeister, Russell, Pariante and Mondelli (2014) found suggestive evidence of abnormal inflammatory biomarker levels in severe mental illness. This suggests an association between inflammation and psychiatric disease. Allergies can be a source of great inflammation within the body and rank as one of the most common chronic conditions in the world. It may be that at least one subtype of BD is biologically associated with the inflammation caused by allergies. Such a link could provide insight into new BD treatment, aiding a population in dire and desperate need. This project aims to elucidate potential links between BD and allergies. A pathway enrichment analysis was used that examines point mutations in genes to see if particular pathways linked with bipolar are also linked with allergies. A genome-wide association study of BD was obtained from the database of Genotypes and Phenotypes (dbGaP) and used for statistical analysis.

A Sustainable Solution for Lighting and Ventilation of Portable Restrooms Using Renewable Energy Resources (Mini Grant)

Jackson T. Osborn, Electrical Engineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Carolina Guerrero-Rocha, Electrical Engineering
DC - College Engineering and Applied Sciences

Mentor: Dr. Jae-Do Park, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:

There is a need for an alternative, sustainable solution for developing areas that lack adequate waste and electrical infrastructure to provide lighting and ventilation for use of a portable restroom day or night. This project seeks to investigate the application of microbial fuel cells as a power source for energy harvesting, in addition to a solar panel and a micro-wind turbine that charge a lithium polymer battery pack. The main goal is to develop a self-sustaining system that requires little to no maintenance that is able to harvest energy from multiple sources. The battery would provide power for the loads (light, fan and single-board computer). The single-board computer will provide the necessary PWM (pulse-width modulation) required for the DC-DC converters and will also serve as the data acquisition system to monitor the outputs of the various sources. A microbial fuel cell relies on electrogenic bacteria that metabolize carbon sources from which they extract electrons. The electrons are accepted by the anode and thus produce electricity. An existing fuel cell has provided the basis for this project. This fuel cell can produce up to 300 mV. Our fuel cells will be a similar design that is scaled up in size. The objective of this project is to provide a working prototype that demonstrates the ability to power LED lighting and a fan for ventilation. This project could provide useful insight into development of systems that could operate on a larger scale.

Illustrated Book for Vocal Empowerment (Full Grant)

Melisande I. Osnes, Visual Arts (UROP Recipient)
DC - College of Arts and Media

Mentor: Mr. Quintin Gonzalez, Visual Arts, DC - College of Arts and Media

Abstract:

In May of 2016 I traveled to Shirtati Tanzania to work with an organization called Maji Safi. There I worked with the female hygiene program to facilitate the young women in the program in illustrating a book on their coordinator, Linda Arrot's voice. This book, written by Linda and illustrated by the young women, serves as a tool for their vocal empowerment program. I took the line drawings the young women did and colored and compiled them together to create a cohesive aesthetic. For example I designed a fabric pattern using the designs drawn by the young women for Linda's dress so that, even though she was drawn differently by every girl, it was clear who she was throughout the book. This book was distributed to every young woman in the program. Allowing them to feel ownership of a finished product while also helping them understand what vocal empowerment entails.

Blood Flow Measurement as a Tool for Measuring Inflammation of Pancreatic Islets in Type 1 Diabetes.

(Full Grant – CCTSI)

Samantha E. Passman, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Richard K.P. Benninger, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:

Type 1 diabetes is an autoimmune disorder in which the immune cells misrecognize and destroy the insulin producing beta cells in the Islets of Langerhans located in the pancreas and affects approximately 1.25 million people in the United States. Infiltration of the islet by T-cells or insulinitis, causes inflammation in the islets. The purpose of this research was to use non-invasive contrast enhanced ultrasound technology to measure insulinitis by measuring changes in pancreatic blood flow to determine if there are regional differences in insulinitis as revealed by differences in islet blood flow across the pancreas. To measure regional differences in insulinitis, Non-Obese Diabetic (NOD) mice which mimic the Type 1 diabetes disease course in humans were injected with lipid microbubbles and burst using a high-mechanical-index pulse. The rate of recovery of the bubbles flowing into the pancreas after bursting was then measured using ultrasound. As diabetes progresses, there are changes in average rate of blood flow and vessel diameter which indicate inflammation changes within the islets, these values were measured across three sections of the pancreas. Overall, variability in rate of blood flow and vessel diameter across the pancreas with disease progression was not detected suggesting that there are no significant regional differences in pancreatic inflammation in NOD mice. In contrast to the changing islet density distribution across the pancreas due to its shape in humans, it appears that there are no regional differences in islet density and blood flow associated with insulinitis in NOD mice.

Opting Out of Preventative Medical Care: the association between becoming widowed and mammography utilization in the U.S. (Mini Grant)

Krysta A. Pelowich, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Patrick M. Krueger, Health and Behavioral Sciences, DC - College of Liberal Arts and Sciences

Abstract:

Marital transitions, specifically widowhood, are associated with various health and health behavior outcomes but have not been linked to health care utilization. Our study examines whether the death of a spouse causes a woman to change her mammography behavior. Mammography is an ideal outcome because it results in improved breast-cancer treatment outcomes at the population level, but women may avoid them due to high levels of false positives. We focus on contrasting theories that suggest how mammography behaviors may change after the death of a spouse. The fatalism perspective argues that the death of a spouse may lead women to become socially isolated and emotionally distressed, and that she may be more likely to forgo preventive health care. Alternately, the renewed commitment to life perspective suggests that women may respond to the death of a spouse by recommitting to her own health and pursuing healthier behaviors, including increased mammography utilization. We will also examine whether education modifies the association between the death of a spouse and women's mammography behavior. Our data come from the Health & Retirement Study, a longitudinal study of adults aged 51 and older in the United States. We use multilevel growth models to test our hypotheses.

Benzodiazepines and Their Dual Administration with Ethanol Increase Accumbal Transient Dopamine Release Events (Full Grant)

Dylan R Rakowski, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Katherine J. Pultorak, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Scott A. Schelp, Biology, Psychology
DC - College of Liberal Arts and Sciences

Gregory Krzystyniak, Physics
DC - College of Liberal Arts and Sciences

Mentor: Dr. Erik B. Oleson, Psychology, DC - College of Liberal Arts and Sciences

Abstract:

Drugs of abuse are commonly thought to increase the concentration of dopamine in the nucleus accumbens (NAc), although their effects on phasic dopamine release events remains to be fully characterized. Here, we are assessing the action of dual-administration of ethanol and benzodiazepines on accumbal dopamine release events. Using fast-scan cyclic voltammetry (FSCV) performed in the freely-moving rat, we first assessed the effects of benzodiazepines (0.3-1mg/kg IV) on accumbal dopamine release. We found that two distinct benzodiazepines, diazepam and zolpidem, increase the frequency of dopamine release events, but decrease the concentration of dopamine per release event. This effect was consistently observed in both the core and shell subregions. Previous FSCV studies from the Robinson' lab demonstrated that ethanol increases both the frequency and amplitude of accumbal dopamine release events. We then assessed for changes in dopamine concentration after treating animals with a range of ethanol doses (0.125-2g/kg IV) followed by 1.0mg/kg IV diazepam.

Comida en Cuba: The Future of Sustainable Agriculture in Changing Political Climates (Mini Grant)

Claire Ransom, International Studies (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Sasha Breger Bush, Political Science, DC - College of Liberal Arts and Sciences

Abstract:

When the Soviet Union fell, it took Cuba down with it. The small island nation lost access to fuel and fertilizers, and thus very quickly to food. Forced to quickly innovate solutions, they established organoponicos, or small urban farms in the heart of the city. Today, nearly three decades later, urban agriculture serves a form of social justice in the city of Havana, providing healthy, local food to those who need it most. In comparison, in cities in the United States, food often travels thousands of miles and frequently comes from large-scale farms with heavy pesticide and fertilizer use. This system is neither beneficial for human and environmental health nor sustainable in the long term. While sustainable development has been a hot topic in research, tangible solutions like organoponicos are only just starting to be recognized on an international scale. However, as relations with the United States change, it is unclear how these systems will be affected. As such, this research will address the sustainability and potential future of Cuba's organic agricultural systems, particularly as international relations and politics shift.

Src Tyrosine Kinase Activation in *Xenopus laevis* Fertilization (Full Grant – CCTSI)

Hinal Rathi, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Leslie Simmons, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Bradley J. Stith, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

Src tyrosine kinase (Src) is a non-receptor enzyme that places a phosphate group onto a tyrosine found on other proteins, and this can turn on or off the activity of the other protein. Src plays a role in cancer, Alzheimer's Disease, and fertilization. Understanding of how this kinase is regulated is important but still unclear. Dr. Stith's lab has found that a lipid named phosphatidic acid (PA) can bind to and activate Src. Src activation involves changing from an inactive tight conformation, where the domains of Src are bound up, to a "loose" configuration. This change is due to the breaking of two sets of weak bonds: one set of bonds that must be broken is between the SH2 domain of Src and the c terminal phosphorylated tyrosine 527, and the second set is between the SH3 domain and a proline-rich linker domain. Thus, dephosphorylation of tyrosine 527 can help Src unfold and this leads to activation. Finally, phosphorylation of tyrosine 418 occurs and this causes the movement of the activation loop out of the active site, the site is no longer blocked and Src can phosphorylate substrates. We have shown that Src is activated by recording a decrease in tyrosine527 phosphorylation that occurs simultaneously with an increase in tyrosine 418 phosphorylation. These results suggest that PA induces a cycling of Src activity. To continue this evaluation of how Src is activated, we will quantify other Src sites as to whether phosphate has been placed on certain amino acids located there (phosphorylation). Through Western Blotting with antibodies specific to phosphorylated sites, we were able to quantify phosphorylation at other regulatory sites (which are also present in humans). We also have preliminary data showing threonine 420 phosphorylation increases with PA addition and this may induce removal of the activation loop from the active site.

Vascular Ventricular Coupling Ratio Outcomes Study (Mini Grant)

Adam Rauff, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Kendall, Hunter, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:

The focus of the project is a disease of the heart and lungs called Pulmonary Hypertension (PH). More specifically, this research initiative targets PH amongst a pediatric population. Strictly speaking, PH is a microvascular disease that induces a high resistance to blood flow in the pulmonary circulation. The fine blood vessels in the pulmonary circulation narrow, and the increased long term blood pressure causes fibrosis in the arteries, which is characterized by thickening and stiffening of the vessels yielding increased blood pressure. The right side of the heart, which pushes blood to the lungs, cannot cope with this state, which eventually leads to death in the majority of cases. The disease most commonly originates in children as a result of genetic heritage or Drug-toxin induced, classified as idiopathic, or along with congenital heart defects, classified as associated. PH is a fatal disease that progressively deteriorates individuals' lives and remains with no cure. In order to diagnose the disease, a physician will utilize a variety of non-invasive measurements such as echocardiography, electrocardiograms, x-rays, and light exercise tests. The clinical tools mentioned above are instrumental in the diagnosis, however, cardiac catheterization, an invasive tool, remains the gold standard in the identification of PH. Catheterization may take place under systemic anesthesia, which poses an undesired risk, particularly in pediatric patients. Furthermore, the current standard of care involves a metric named pulmonary vascular resistance (PVR) that is derived from catheterization. This measurement approximates the resistance to flow in the main pulmonary artery. While PVR provides insightful information about the mechanical state of the heart, and subsequently the progression of the disease, it does not adequately capture the dynamic nature of heart acting as a mechanical pump. Vascular ventricular coupling ratio is a metric that has been around the cardiovascular research community for over 30 years, yet it has not been integrated into standard clinical care. VVCR originated as a measurement that takes volumetric and pressure measurement to compare the distensibility of the walls of the heart to the walls of the pulmonary vasculature. Other research groups have conducted experiments on canine where the main pulmonary artery was occluded, and a predictable VVCR was obtained. Thus, VVCR allows physicians to better evaluate the current state of the heart compared with a hypothetical scenario of heart failure, where the right ventricle can no longer push blood into the pulmonary vasculature due to increased resistance. In this project, we conduct an observational retrospective clinical study target at the exploration of a new metric called vascular ventricular coupling ratio (VVCR). The project will involve a statistical analysis of longitudinal data involving a variety of metrics

derived from standard of care such as blood pressure, blood flow, resistance. These metrics will be compared with our calculated VVCR. Finally, we plan on evaluating what metrics can be used as the most useful predictors of hard outcomes such as death, hospitalization, or lung transplantation.

Spatial Analysis and Linear Regression of Infant Mortality Rate, Social Disadvantage, and Healthcare Access (Mini Grant)

Alex D Romero, Sociology, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Adam M. Lippert, Sociology, DC - College of Liberal Arts and Sciences

Abstract:

While the US infant mortality rate (IMR) has declined in recent decades, racial disparities remain. The IMR is considerably higher in counties with higher proportions of Black Americans than more racially homogenous counties. Research indicates that social disadvantage and health care access may contribute to these differences, though few studies have considered these factors simultaneously. The current study addresses this gap by merging social disadvantage data from the American Community Survey (ACS), healthcare access data from the Area Health Resource File (AHRF), and infant mortality data from the CDC. Spatial analysis and cartographic methods demonstrate the spatial distribution of infant mortality and its correspondence to racial composition across 178 US urban counties. Ordinary linear regression models reveal a positive association between the county-level proportion of Black Americans and infant mortality. This relationship is attenuated with the addition of a measure of social disadvantage, which itself is positively associated with infant mortality. The positive association seen is also decreased with the addition of a standardized measure of hospital beds and nonfederal office based pediatricians, which are positively and negatively associated with infant mortality respectively. However, once all variables above are considered together the associations seen from AHRF variables are attenuated by social disadvantage and are no longer significant. Therefore, overall findings suggest the concentrated disadvantage is a confounding variable for healthcare access and IMR outcomes at the county level. These findings highlight the importance of adjusting for the measures of both social disadvantage and healthcare access when analyzing infant mortality outcomes.

Analysis of Ingroup Bias: Understanding How Individuals Maintain In-Group Advantages Under Cognitive Stress (Full Grant – CCTSI)

Joseph F. Rosales, Psychology, Sociology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jim Grigsby, Psychology, DC - College of Liberal Arts and Sciences

Abstract:

In-group bias is the tendency to benefit members of one's own groups over members of other groups. Also, stress is known to greatly influence an individual's implicit behaviors. In this study, we are investigating if individuals under stressful conditions are less likely to share resources with individuals from different ethnic backgrounds and more likely to share with similar individuals demonstrating in-group bias. To measure this, we first asked participants to complete a timed math task termed the Paced Serial Auditory Addition Task (PASAT) in which participants have to quickly add two single digits together. Most participants found this test somewhat difficult and mildly stressful. To measure in-group bias, we used a procedure from behavioral economic game theory, the dictator game, which is designed to assess how willing people are to act against their sole interest and share economic resources. In our findings, we found that individuals were more likely to share fewer resources with individuals from dissimilar ethnic backgrounds.

Induced Hyperthermia of Tumors using Near Infrared Radiation and Photothermal Nanoparticles (Mini Grant)

Hunter Sauerland, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jung Jae Lee, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Photo thermal molecules absorb energy from electromagnetic radiation into thermal energy. It is thought that this heat can be used in body tissues to combat cancer by inducing localized hyperthermia. Due to the ability of body tissues to absorb many wavelengths of light however, it can be unfeasible to induce hyperthermia at the site of a tumor without also destroying body tissues above and below the tumor. Near infrared radiation with a wavelength around 700 nm to 900 nm is known to have low absorption by body tissues and as such deep penetration. The compound cypate is known to absorb light at 780 nm. If cypate was placed at the site of the tumor then near infrared light would be able to cause localized hyperthermia at the site of the tumor without also destroying healthy tissue. Due to commercial unavailability, cypate was synthesized and purified in the lab. Cypate was then conjugated with chitosan to form nanoparticles. The thermal capabilities of cypate was then analyzed by exposing it to a laser emitting near infrared light. H-NMR testing shows that a pure sample of cypate was produced for use in testing. The laser testing concluded that cypate could induce localized hyperthermia great enough to kill a tumor.

Calcium-Inhibition of SLP-2 C2A (Mini Grant)

Timothy A. Spotts, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jefferson Knight, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Cell-to-cell communication plays an important role in maintaining homeostasis in a multicellular organism. In humans, the circulatory system gives the body of means of transporting nutrients to various tissues. When the amount of blood glucose is high after eating a meal, the body must have a means of storing excess nutrients for later; when blood glucose levels are low, after intense exercise or fasting, the body must have a means of unlocking the stored nutrients for distribution. The pancreas is responsible for detecting changes in blood glucose levels and transmitting signals to promote a proper homeostatic response by a cell somewhere else in the body. These chemical signals are known as hormones. The Knight Lab studies proteins that are involved in the release of hormones via a mechanism known as exocytosis. These proteins contain the ability to bind to cell membranes to facilitate the release of hormones in the blood stream. This project shows the rare ability of calcium to prevent the binding of one such protein to the cell membrane.

The Methodology of Camera Placement in Urban Wildlife Monitoring Initiatives (Full Grant)

Jamie L. Stedman, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Laurel Hartley, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

Urban sprawl and the growth of the population have created several challenges that humans face when they come into contact with the animals living nearby. The occurrence of these challenges has displayed that there is a need to study and develop in a way that keeps these animal populations in mind, for both the ease of the humans and the animals. Uninformed human sprawl can lead to eradications of animal populations, infestations and damage of habitats. This is the intersection where urban wildlife monitoring comes in. Through the use of camera surveying, information can be gathered about these animals, which can be used in many ways to create a better-shared environment. The placement of these cameras for surveying can be an integral part of a study, therefore it is important to consider the mechanism for camera placement, including location size, distance between cameras, and the area a camera may be deployed. Through the use of different methods, a variety of information may be gathered. This variety of information may be useful in attaining a wide range of data for the Urban Wildlife Information Network (UWIN).

Binding Sites of Granuphilin C2A with Negatively Charged Lipids (Mini Grant)

Sherleen Tran, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Nara L. Chon, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Insulin secretory vesicles are docked to the plasma by Granuphilin C2A in preparation for exocytosis. However, the detailed mechanism of this binding process is unclear.[1] It was hypothesized that the positively-charged lysine cluster of the β -4 sheet of the C2A domain was the primary interacting binding site with the negatively charged head group of the lipid molecules.[2] Here we combined molecular dynamics and docking calculations to test this hypothesis. A granuphilin C2A model is constructed and solvated in water. To partly account for the protein flexibility, multiple representative protein geometries from the 200-ns equilibrated trajectory as well as the experimental structure were used for docking calculations. In silico mutation on selective lysine residues were performed to these geometries, which were used in docking calculations. The data confirmed that the β -4 sheet of the C2A domain plays a key role in the binding of the lipid with granuphilin C2A. Acknowledgements: This work was supported by Dreyfus Foundation (TH-14-028), and NVIDIA Corporation, and used computational resources of XSEDE (140070) and NERSC (m2495). [Ask Dr. Knight for NIH grant number]

Investigating Zar Function Through Engineered Mutants (Full Grant)

Ashley M. Trumpie, Biology Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Sarah Russo-Pearl, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Jericho Oviedo, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Amanda Charlesworth, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:

Zygote arrest (Zar) proteins are critical for embryonic development. The Zar mechanism of action is not currently understood, but it is known that they bind to RNA and regulate protein synthesis. Two active mutants were developed as potential tools to investigate Zar function. One was a truncated Zar C-terminal (CCZar), the other had a deletion in the N-terminal (ΔN). Mutants retained the RNA-binding domain and lost the protein-synthesis domain. Control inactive mutants were created with a disrupted RNA-binding domain. Mutants were successfully made as verified by restriction digest analysis. DNA sequencing verified the expected mutations had been introduced. RNA encoding the Zar mutants was transcribed and microinjected into frog eggs and embryos. Western blot confirmed the expressed mutant proteins were the right size. Experiments showed when active ΔN -Zar mutant was expressed a two-hour delay to meiosis was observed in frog eggs. This was not seen with the inactive ΔN -Zar mutant. In frog embryos, the active ΔN -Zar mutant was correlated with apoptosis and/or neural tube deformation, which were not seen with the inactive ΔN Zar mutant. The frog eggs and embryos injected with active CCZar mutant did not exhibit significant differences from any controls. Western blots suggested CCZar was expressed at the right size, morphological observations were inconsistent between samples. Thus, this study created an effective tool (ΔN -Zar) that will be used in future to better discern the role of Zar in early development and embryogenesis. CCZar was not an effective tool, but may still be used as an inactive specificity control.

Computational Study of Chloride Transport through the E. coli Cl⁻/H⁺ antiporter (Full Grant)

MacKenzie Zarecki, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:

Cl⁻ transport proteins control the selective flow of Cl⁻ ion in the regulation of pH, blood pressure, membrane excitability, etc. Malfunction of the ion channel leads to diseases such as myotonia congenita, Bartter syndrome, and epilepsy. We study the Cl⁻ transport pathway in E. coli CLC Cl⁻/H⁺ antiporter 1 by various computational methods.² Steered molecular dynamics simulation investigates the dragging force of Cl⁻ through the pore. Umbrella sampling is used to estimate the free-energy barrier of Cl⁻ Conduction. The calculated potential of mean force along the translocation path implies the readiness of passing Cl⁻ down the channel, as the barriers are rather small (~2.0 kcal/mol). Acknowledgment: This work is supported by the NSF (CHE-1564349), Camille & Henry Dreyfus Foundation (TH-14-028), and NVIDIA Corporation. This work used XSEDE under grant CHE-140070, supported by NSF grant number ACI-1053575, and NERSC under grant m2495.