Sigma Xi

3 - 5 p.m.
Oak Room

SIGMA XI
THE SCIENTIFIC RESEARCH SOCIETY

Synthesis and Characterization of Co(II) Model Complexes for Liver Alcohol Dehydrogenase
Undergraduate: Emilse Almanza '19, Sam Zygmont '20

Abstract: We have previously prepared a series of tridentate pincer ligands, which have two-sulfur and one-nitrogen donor atoms (SNS) developed from either bis-imidazole or bis-triazole precursors. Furthermore, the tridentate SNS ligands include thione subsituted imidazole or triazole moieties. Through the use of 2,6-dibromopyridine as a ligand precursor, we have developed slightly rigid ligand systems that have been made more flexible through the incorporation of methylene linkers into the pincer ligand. This was accomplished by using the starting material 2,6-(dibromomethyl)pyridine. While we have successfully metallated our ligand precursors to form tridentate zinc(II) complexes, we are now interested in preparing cobalt(II) complexes that also contain these ligand precursors in order to model the cobalt analog of liver alcohol dehydrogenase. The SNS cobalt(II) complexes and ligand precursors were characterized via NMR spectrometry, ESI-Mass spectrometry, electrochemistry, UV-Visible, and X-ray diffraction. A more detailed description of the synthesis and characterization will be presented.

Scholarship: Hardiman Scholars, Lawrence
Faculty Mentor: Dr. John Miecznikowski

RF Energy Harvesting for Embedded System Applications
Undergraduates: Philip Amarante '18, Crystal Salazar '18, Jeff Dejean '18, Antonio Tello '18

We as humans communicate in a variety of ways using RF signals. With the use of antennas and transmitters, an RF field can be used for various types of wireless broadcasting and communications. This method of communication impacts all the technology we use today such that it has led us to be more interconnected globally than ever before. Some of the ways we communicate using RF signals include: television broadcasting, radar systems, computer and mobile platform networks, remote control, remote metering/ monitoring, and many more. With RF communication in so much of our technology all across the world, RF signals are all around us being transmitted and received. In our present day society, there is a focus on finding clean and reusable energy sources. These RF signals that our devices transmit have energy that we can utilize. RF energy harvesting is the concept of generating power from the radio frequency signals travelling around us. This type of power generation will essentially be recycling the energy given off from RF transmitting technology. By harvesting the RF energy using an antenna and converting it to charge a supercapacitor, we can lead a way to clean and recyclable power generation.

Faculty Mentor: Dr. Uma Balaji

Gas Storage Design for Solar Powered CO2 to Fuel System
Undergraduates: Ethan Ammon '18, Johnathon Menz '18, Lauren Calderoni '18, Joseph Maini '18

Abstract: Recycling CO2 and converting it into fuel in an efficient manner can be a solution to a worldwide need to reduce CO2 and produce alternative fuel in a cost-effective way. There exists a theory for a chemical plant system operational on natural gas by harnessing solar power during the day, and through a series of chemical reactions, converts CO2 and CH4 into a usable fuel. For a 24-hour continuous operation, a high-pressure tank stores some of the byproduct gas throughout the day and uses it at night. This chemical plant involves a series of pressurized tanks and piping connections that will safely convert the carbon dioxide with the aid of natural gas into a useful fuel. Our involvement in this process was to design and analyze modular, transportable pressure vessels for gas storage of the chemical facility. Our goal was to also increase the efficiency of this process through the integration of heat exchangers and expanders into the system. In conclusion, the end goal was to have a safe, cost-effective, and efficient unit that satisfies the chemical facility requirements.

Scholarships: Lawrence
Faculty Mentor: Shahrokh Eternad

Rethinking the Organic Chemistry Laboratory Curriculum at Fairfield University
Undergraduate: Emily Berube '18

This project set out to answer the following questions: 1. Do we deliver the laboratory curriculum we say we deliver? 2. Can we update specific laboratories to better align our existing curriculum with our recently developed curriculum map? 3. Can we modify specific laboratories to incorporate more green chemistry elements, more spectroscopic analysis, and more macromolecular (polymer) chemistry? This poster outlines progress made on all of these fronts with an overview of our existing curriculum, examples of modified laboratories, and plans for incorporation of new laboratory experiences in the coming year. Three laboratory experiences involving a Grignard reaction, esterification using DMAP, and a new macromolecular laboratory exercise where developed and deployed during the spring 2018 semester. The success of the new laboratory experiences, student and faculty responses to them, and a careful analysis of how they fit into the existing curriculum is included in this presentation.

Scholarship: Hardiman Scholars
Faculty Mentor: Lawrence Kraig Steffen

The Analysis and Application of the Emergent Electronic Properties of Self-Assembling Nucleopeptide Systems
Undergraduates: Samantha Brown '19, Kayley Chapeton '20

Abstract: Biomolecular structures are held together by a complex network of molecular interactions that direct and stabilize assembly. In order to translate the fundamental molecular interactions of biomolecules into the design of functional biomaterials, we have developed and synthesized a model system that integrates nucleic acids and self-assembling peptides. These nucleopeptides serve as a small-model system for the study of the non-covalent molecular interactions involved in biomolecule self-assembly, and are able to act as an electronic circuit system that can be characterized by spectroscopic and electronic properties. The emergent electronic properties found within the nucleopeptide library, which were measured by Electrical Impedance Spectroscopy (EIS) and analyzed by ZMAN software, indicate that the properties of the nucleopeptides are applicable to those of a Battery and Supercapacitor, with a specific focus on electrical impedance measurements. Collectively, these studies on nucleopeptide supramolecular structure assembly have the potential to contribute to the design of functional biomaterials that are able to conduct and store electrical charge.

Scholarship: Lawrence
Faculty Mentor: Jillian Smith-Carpenter

Temperature effects on feeding kinematics in cunner, a hibernating labrid fish
Undergraduate: Rachel Carlowicz '18

Cunner (Tautogolabrus adspersus) are a temperate labrid that can be found along the coast of Northeastern North America from Virginia to Nova Scotia. During winter, cunner enter a state of extended torpor in order to conserve energy. In cunner, locomotor muscle function and performance is inhibited when temperatures drop below 10C. To further understand the effects of temperature on ecologically relevant tasks, we asked, how is feeding activity influenced by a decrease in temperature? Our study investigated the feeding kinematics of cunner at varying temperatures (20C, 15C, 10C, 5C). We hypothesized that the kinematic variables would be slower at lower temperatures. Seven cunner were fed pieces of sandworm and Asian shore crabs. For each individual, we recorded three feeding events for each prey type at 500 frames s-1. We analyzed: gape, gape velocity, ram, ram velocity, time to prey capture, prey velocity, and distance to prey at mouth opening. In support of our hypothesis, there were some variables that were influenced by the colder temperatures. We saw some significant differences between the 5C fish and the other temperatures. Prey type did not influence feeding kinematics. Further studies will investigate other northern labrids, like tautog, to see if colder temperatures decrease feeding performance.

Scholarship: Hardiman Scholars
Faculty Mentor: Shannon Gerry

Implementing Treatment Outcomes at Silver Hill Hospital
Undergraduates: Brianna Cerrito '18, Julianne O'Connell '18,

Abstract: This project serves as an evaluation of the efficacy of inpatient treatment at Silver Hill Hospital, which uses Dialectical Behavior Therapy to treat several comorbid mental illnesses, such as anxiety, depression, and substance use disorders. Three predominant measures are observed to evaluate efficacy: Generalized Anxiety Disorder 7-item (GAD-7) Scale, Patient Health Questionnaire 9-item (PHQ-9) Scale, and DBT-Ways of Coping Checklist. We will be presenting preliminary findings based on our work at Silver Hill Hospital under the direct supervision of Dr. Frank Buono.

Faculty Mentor: Dr. Frank Buono

Identification of Probiotic Bacteria in Commercial Foods and Dietary Supplements Using MALDI-TOF MS
Undergraduate: Christine J. Colasacco '18

The term probiotic refers to a microorganism that provides health benefits to its host. Benefits thought to be conferred include healthy functioning of the immune system, vitamin absorption, and food digestion. Today, many foods and beverages, such as dairy products (e.g. yogurts and cheeses), fermented vegetables (e.g. kimchi) and fermented beverages (e.g. kombucha), contain probiotic microorganisms. The labels of many of probiotic products often include the identification of microorganisms at both the genus and species level. However, probiotics are not subject to oversight by the Food and Drug Administration and there is no regulatory agency confirming label identifications. In this study, 18 bacterial strains from commercial probiotic products were cultured and identified using Matrix Assisted Laser Desorption Ionization Time of Flight Mass Spectroscopy (MALDI-TOF MS). Identifications were compared to identifications made by Biolog phenotyping and 16S rRNA gene sequencing. Twelve out of 18 MALDI-TOF MS identifications matched the identification on the probiotic label with greater than 80% confidence. Ten of the identifications were confirmed by phenotyping and 16S rRNA gene sequence data. Research to identify the six remaining strains is ongoing.

Scholarship: Hardiman Scholars
Faculty Mentor: Dr. Olivia Harriott

Functional requirements for substrate binding and proteolysis of human insulin-degrading enzyme
Undergraduate: Samantha Cooper '18

Abstract: Insulin-degrading enzyme (IDE) is a Zn2+-metalloproteinase that degrades proteins such as insulin and amyloid beta. Our project aims to analyze various functional requirements of the IDE active site residues that affect substrate binding, specificity and proteolysis using a mutational analysis of bacterially expressed human IDE and kinetic studies using fluorogenic resonance energy transfer (FRET) derivatives of human insulin and amyloid beta peptides. The cloning, expression and purification of human IDE and IDE mutants was accomplished by our collaborators in Prof. Alper's laboratory at Sacred Heart University. Kinetic assays and proteolytic cleavage site mapping using MALDI-TOF mass spectrometry and post-source decay sequencing were performed to analyze substrate binding, specificity and proteolysis. The results from our studies will better define the functional conditions for the conservation of hydrophobic and aromatic IDE active site residues, which aid in proteolysis. Using this study's findings may prove beneficial in designing IDE inhibitors or by engineering various mutant forms of human insulin that alter the rate of IDE proteolysis.

Faculty Mentor: Jillian Smith-Carpenter

Delta
Undergraduates: John F. Crowley '19, Matt Richardson '18, Peter Julian '18, Chris Kelly '18, Nick Zazula '18

The purpose of this game is to teach users the fundamentals of programming across the various programming languages. We are not aiming to teach the exact syntax of languages, such as Java and Python, but to explain the theory behind various programming concepts. In the game, we will attempt to teach the user about control statements, sorting algorithms, data structures, and the importance of commenting. We will tackle this challenge by presenting the user with various challenges to complete, while also explaining how these relate to the world of programming. The game is designed so you can access any level at any time. You start in the home town, and you can walk around and enter buildings that will have a task for you to complete. Those tasks will be teaching you the logic behind simple problems of programming. It is a simple and lightweight game that is easy to advance on. There is plenty of space on the map for continued development so the user can interact with the game in new and impressive ways. Delta is set up as a 2D top down game. This is where your playing the game with a bird eye view the character. Since it is so easy to conceptualize and continue to develop the game is ever changing and ever expanding based on user need and industry standards.

Faculty Mentor: Amalia Rusu

Medical Guide Wire Proximal End Deburring Machine
Undergraduates: Jerome Davis '18, Peter Colliard '18, Jack Crowley '18, Christian Adamczyk '18

A medical guide wire is used during surgery to determine the depth of incisions. The guide wire is cut from a spool leaving local deformations and burred ends. The burred ends create inaccurate depth measurements of incisions. A laser is used to mark the guide wire after being cut The purpose of this project is to automate the deburring process. By creating a system to move the wire from a number of wires. The software combined with sensors, rollers, and a three finger gripper, is used to position the wire on the same axis as the laser beam. This will yield a dome shape at the tip of the wire, so the patient in surgery is not harmed by any burrs on the tip of the wire. Using a laser will prevent bending and additional burrs that the previous deburring method would produce. Failure to hold the integrity of the wire may result in inaccurate incisions during surgery. This system will lower the cost of labor, produce accurate results, and reduce the potential of damaged wires, all of these effects will save money for Northeast Laser Engraving, and deliver consistent results for the medical guide wire used in surgery.

Faculty Mentor: Michael Zabinski

Quantification and Comparison of Biotin in Salon Brand and Generic Brand Shampoos
Undergraduate: Kimberly DelBianco '18, Lydia Dupree '18

Biotin is a well-known B vitamin capable of strengthening hair and preventing hair loss. Many hair care brands market their strengthening shampoos by focusing on biotin as the key component. Through the use of a microplate reader, we aim to quantify the amount of biotin in both salon-brand and generic brand shampoos relative to the total protein amount in order to determine if there is a difference in the amount of biotin present in each brand. As salon-brands are more expensive and are marketed as better for your hair, we hypothesize that there will be a greater amount of biotin present in the salon-brand shampoo than in the generic brand. These findings may inform consumers of the more biotin-rich shampoo option for their hair strengthening needs.

Faculty Mentor: Matthew Kubasik

Solution Phase Synthesis and Spectroscopic Characterization of Self-Assembling Nucleopeptides
Undergraduates: Kimberly DelBianco '18, Jovelt Dorsainvil '19

Biomolecular structures are held together by a complex network of molecular interactions that direct assembly and stabilize structures. In order to translate the fundamental molecular interactions of biomolecules into the design of functional biomaterials, we have developed a model system that integrates nucleic acids and self- assembling peptides. These nucleopeptides serve as a small-model system for the study of the non-covalent molecular interactions involved in biomolecule self-assembly, and can be characterized by different spectroscopic techniques for emergent electronic properties. We are currently characterizing the nucleopeptide assemblies by UV absorbance and fluorescence spectroscopy. We are also developing protocols for solution-phase synthesis of the nucleopeptides as a more efficient way to scale up and expand the nucleopeptide library.

Faculty Mentor: Jillian Smith-Carpenter

Automatic Spherical Bearing Torque Loosening Machine
Undergraduate: John Delaney '18, Gina Caiafa '18, Jack Alderisio '18,

Abstract: A spherical bearing is a bearing that allows for angular motion in two directions along a center point. Spherical bearings come in different forms including narrow, wide, and self-lubricating and are designed to meet certain military and commercial standards. After the spherical bearing is made the rotational breakaway torque on the spherical bearing is checked in accordance with the Aerospace Standard. If the torque is too high in the bearing, the torque needs to be adjusted to fit the required range dependent on the size of the bearing. This adjustment is performed by a torque loosening machine which loosens the bearing dependent of the pressure set. This process is repeated until the desired torque value is reached The goal of this project is to design a process and identify equipment that should be used for automatic spherical bearing torque loosening. The first part of the project will be to analyze the torque loosening process and to find the relationship between the set pressure and torque value. The next part of the project would be to design a machine with data to loosen the torque in one cycle and display the torque value. The process should take forty seconds.

Faculty Mentor: Joseph McFadden

Evaluating the Nutrient Composition of Food Offerings Across On-Campus Dining Options
Undergraduate: Lydia Dupree '18, Layra Cintron-Rivera '18, Alexander Gaito '18

This project examined the nutritional content of food offerings across campus. Food items offered at the dining hall, snack bar, vending machines, and the coffee and bagel shop were analyzed to determine whether the nutrient content of food offerings differed. We found that nutritional quality of food items significantly varied across on-campus dining locations and between meals. In the dining hall, there were significant differences in the nutrient composition of food items between meals. The coffee and bagel shop provided food items with significantly greater amounts of sodium, sugar, and saturated fat on average, while also providing items with more fiber per serving. The dining hall offered food options with the least amount of saturated fat per serving, in addition to significantly less sodium and sugar, as compared to the coffee and bagel shop and the snack bar meal stations. Surprisingly, foods available in vending machines contained significantly less sodium per serving on average compared to all other locations, in addition to less sugar, saturated fat, and more fiber per serving than food items available at the coffee and bagel shop. Our findings also suggest that nutrient availability varies between the food offerings within the campus snack bar, thereby affecting the nutrients available to students at each of the stations.

Faculty Mentor: Dr. Catherine Andersen

Liver X Receptor (LXR), HDL, and HDL-Associated Proteins Regulate Chronic Myelogenous Leukemia Cell Differentiation
Undergraduates: Lydia Dupree '18, Kaley McMullen '19

Liver X receptors (LXRs) are oxysterol-activated nuclear receptors involved in the regulation of cholesterol transport, glucose metabolism, and inflammatory responses. We have previously seen varied effects on cholesterol metabolism and cellular differentiation upon treatment of the human erythroleukemia K562 cell line – a model for chronic myelogenous leukemia (CML)– with the LXR agonist TO9O1317, as well as, a difference in the modulation of the K562 cell viability upon treatment with lipoproteins (HDL and LDL) and HDL-associated proteins (apolipoprotein A1 (apoA1) and serum amyloid A (SAA)). In this study, we investigated the effects of the LXR agonist and lipoprotein treatments on the modulation of cellular differentiation. Overall, the findings suggest that treatment with TO901317-induced LXR activation decreases cholesterol concentration and increases hemoglobin concentration in K562 cells, and the paired culture with LDL and HDL-associated lipoprotein and treatment with TO901317-induced LXR activation differentially modulates gene expression that is indicative of differentiation of CML cells to the erythrocyte and megakaryocyte lineages. These findings could potentially inform future treatment plans for leukemia patients.

Scholarship: Femia Science Endowment
Faculty Mentor: Catherine Andersen

Synthesis and Characterization of Short Oligomers of Aib
Undergraduate: Brayan Elvir '21

Oligomers of alpha-aminoisobutyric acid (Aib) are known to adopt helical structures at n=5 and higher. To test whether shorter oligomers of Aib can adopt helices at shorter n, we are synthesizing short oligomers of this amino acid. Specifically, we are using a dedicated microwave reactor to investigate efficient peptide bond forming reactions. Some of these molecules will investigated by our collaborators at Purdue University. The poster will present details of the synthesis and characterization (e.g., NMR and MALDI-TOF mass spectrometry) of the oligomers done here at Fairfield University.

Faculty Mentor: Matthew A. Kubasik

Anti-cancer Effects of Oleuropein Olive Leaf Extract in K562 Leukemia cells
Undergraduate: Sophia Fagan '19

Oleuropein is one of the two main phenolic compounds derived from olive leaves, and it has been shown to increase apoptosis in many types of cancer cells. Numerous studies have found that the polyphenols contained in olive leaves possess strong antioxidant properties, suggesting that the compound could be effective in anti-cancer treatments. The purpose of this study was to examine the effects of oleuropein extract on cell growth and viability in K562 human leukemia cells, and begin to investigate possible molecular mechanisms of action. We purified our own extract from olive leaves for these studies. We demonstrated that K562 cells treated with 50-150 ug/ml of oleuropein exhibited significant reduction in cell growth and cell viability after four days when compared to controls. Current studies are being conducted to determine the most effective concentration and duration of treatment for oleuropein-induced cell death. We are also examining cellular cyytotoxicity and cell cycle progression in these experiments using LDH assay and cell cycle staging, and further studies are being conducted to examine inflammatory and antioxidant pathways for their involvement in the anti-cancer effect of the compound in these cells. This research provides a promising new avenue for the use of natural products as anti-cancer agents.

Faculty Mentor: Shelley Phelan

Relating the Chemical and Morphological Character of Plaster Cast Statues to Durability
Undergraduate: Jacqueline Ferreri '18

The Fairfield University Plaster Cast Collection holds a large variety of about 100 plaster casts made in the 19th-20th centuries of famous sculpture from the ancient Greek and Roman period through the Renaissance. These casts, donated or lent from many prestigious institutions, arrived at Fairfield with few records concerning their history and background. Most of the cast collection is held in a stable environment with controlled temperature and humidity levels. With this controlled atmosphere, most of the casts are in stable condition and only one show signs of decay. Scanning Electron Microscopy (SEM) and porosimetry results will be discussed in relation to how morphology and structure affect the stability of the casts. An analysis of the moisture content of each cast will be presented as well. Fourier Transform Infrared Spectroscopy (FT-IR) and X-Ray Diffraction (XRD) data will also be presented in relation to the chemical components of each sample. Overall the goal of this project is to find a way to understand what makes a plaster sample stable and how to better conserve the samples in the university's collection.

Scholarship: Lawrence
Faculty Mentor: Amanda Harper-Leatherman

Adventures in In Vitro Assay Development
Undergraduates: Alex Gaito '18, John Lazzaro

Nicotinic acetylcholine receptors are inotropic ligand-gated ion channels that have been targets for therapeutic drug development. The ion flow through these receptors was measured for both reference and test compounds using calcium and membrane potential dyes and FLIPR Tetra technology. Compound efficacy and potency (I) were determined using the maximum change in fluorescence of the kinetic reads. Future screening of these receptors could include identification of novel compounds or selectivity profiling.

Faculty Mentor: John Lazzaro

K562 Leukemia Cell Fingerprinting via MALDI-TOF and Cholesterol Quantification via GC-MS.
Undergraduates: Justin Gilbertson '19, Tyler Lyons '19, Eunson Hong '19

Matrix assisted laser desorption ionization-time of flight (MALDI-TOF) mass spectrometry is a powerful method for characterizing biomolecules. Routinely used for the identification of microbial species, we describe the use of MALDI-TOF for acquiring spectral fingerprints of eukaryotic K562 cells. Importantly, the number of cells, MALDI matrix and spotting technique affect the quality of the MALDI-TOF fingerprint obtained. Optimal sample preparation involved 1) sinapinic acid matrix, 2) a slurry with matrix spotting technique and 3) 50,000 cells per well. The instrument's raster function further increased reproducibility. We expect fingerprints will reveal phenotypic shifts and differentiation patterns of K562 cells. Gas chromatography-mass spectroscopy (GC-MS) was then used to quantify cholesterol levels in K562 cells, to understand its role in K562 cell growth and proliferation. An internal standard was created, using cholestane to identify optimal GC parameters; cholestane is a sterol produced endogenously from cholesterol and shares a similar structure. The mass spectrometer conveniently identified cholestane and cholesterol in the GC spectra. A standard curve of cholesterol can be used to quantify cholesterol in cellular samples. Knowledge gained from cell culture studies will enable the analysis of clinical samples, the ultimate goal of this work.

Scholarship: Hardiman Scholars, Faculty Student Collaborative Fund
Faculty Mentor: Dr. Aaron Van Dyke

Habitat study of the endangered Anegada Iguana Cyclura pinguis on Anegada
Undergraduate: Alanna Goldy '20

The Fort Worth Zoo organizes the Anegada Iguana conservation program to preserve the endangered species, Cyclura pinguis, as well as to learn about their impact on the habitat they live in. This program located on Anegada in the British Virgin Islands, was set in motion fifteen years ago. Since then it has increased the population of iguanas on the island by capturing juvenile iguanas and releasing them once they are large enough to avoid predation. The purpose of this research was to determine where on the island the iguanas could be found and observe the impacts they have on the environment around them. With the use of baited camera traps, we were able to observe which areas of the island the iguanas inhabited as well as determine which predators also reside in that area. The Anegada Iguana inhabits parts of the island with sandy terrain and lots of vegetation so they can make secluded burrows. While the iguanas are mostly found on one part of the island, their predators are more widespread and can adapt to live anywhere on the island. A method we discussed to preserve the species was to promote awareness so we could provide a sanctuary for the iguanas to live free of habitat destruction, foreign predators and foreign livestock overgrazing plants vital to survival.

Faculty Mentor: Anita Fernandez

Defeat as a Mediator of Depression Symptoms and Suicide Ideation in African Americans
Undergraduates: Andriana Goodchild '19, Chelsea Salvatore '19

Suicide is currently the third leading cause of death in African American young adults (CDC, 2018). One identified predictor for suicidality in African Americans is symptoms of depression (Hollingsworth et al., 2016). Although it is known that depression is a risk factor for suicide, research identifying mechanisms of this relationship is needed. A factor that might explain that relationship is defeat. Defeat is the sense of failed struggle concerning the loss or disruption of a status or internal goal (Gilbert et al., 1998) and is positively correlated with suicide ideation (Panagioti et al., 2013). The aim of this study was to examine defeat as a mediator of the relationship between depression symptoms and suicide ideation in a sample of African Americans. It was hypothesized that defeat would significantly mediate the relationship between depression symptoms and suicide ideation. Participants included 74 African American college students. Results of a mediation analysis using 5,000 bootstrapping samples found that defeat significantly mediated the relationship between depression symptoms and suicide ideation (95% BC CI of .019 to .125), supporting the hypothesis. These results imply that African Americans who experience an increase in depressive symptoms could also have an increase in feeling defeated, which in turn could lead to an increase in thoughts of suicide.

Faculty Mentor: David Hollingsworth

The Relationship Between Social Cognition and Intimate Partner Violence in College Dating Relationships
Undergraduate: Lauren Hart '19, Allison Murphy '18, Mariana Mangini '18, Jennifer Jacobs '18, Anna Ruddat '19

Intimate partner violence (IPV) in college students is alarmingly high (Dardis et al., 2015. IPV in college is a risk factor for later abuse. This study examined the relationship between social cognition (SC) and IPV. Method: 112 students (97 females) ages 18-22 (M=18.9,SD=1.1), completed the MASC (48 multiple choice questions about video clips; the RMET (36 images of eyes expressing various emotions are named), the AAT (participants push or pull a joystick in response to faces for congruent and incongruent (e.g. angry-approach) conditions), and the CADRI (self-report of IPV-Victimization (IPV-V) & Perpetration (IPV-P). Results: RMET was positively correlated with MASC correct (r=.32,p=.01), and with correct AAT scores for approaching happy faces (r=-.19,p=.05), avoiding angry faces (r=-.20,p=.03), and approaching angry faces (r=-.19,p=.05). RMET was negatively correlated with MASC hypomentalizing (r=-.22,p=.02), and hypermentalizing (p=-.21,p=.03) errors. IPV-P and IPV-V were correlated (r=.9,p=.01). Participants with high IPV-V had faster reaction times on the AAT for approaching angry faces, t(77)=2.1,p=.04. Discussion: High IPV-V participants had faster reactions to the incongruent condition of approaching angry faces, suggesting an error in social cognition that may be a risk factor. Results may lead to new interventions for college students at risk for IPV.

Faculty Mentor: Margaret McClure

Pericardial Sac Retractor
Undergraduate: Kathryn Higgins '18, Kaitlin Donohue '18, Jennifer Egan '18, Milgian Moreno-Villatoro '18

Atrial Fibrillation is the most common type of arrhythmia, in which the heart's two upper chambers, the atria, beat chaotically and irregularly, out of coordination with the two lower chambers of the heart, or the ventricles. Patients that suffer from atrial fibrillation often need electrical cardioversion to shock the heart, essentially causing the heart to reset. Other patients use medication to control the heart's rhythm. For patients whose atrial fibrillation is not controlled using electrical cardioversion or medication, alternatives may include catheter ablation or a surgical procedure. An epicardial ablation procedure involves placing a catheter between the heart and pericardial sac to burn or freeze the tissue that cause the disorganized signals to transmit. It is imperative that the ablation procedure creates a transmural lesion that passes through the entire thickness of the atria. At the same time, it is important that the heat from the ablation does not travel to surrounding tissues, such as the esophagus creating dangerous complications. The goal of this project is to build a device that can be inserted through a catheter into the pericardial space behind the atria. This device acts as a shield, protecting the esophagus from damage and creating enough space between the heart and the pericardial sac so that the heat can dissipate before traveling to the esophagus.

Scholarship: Hardiman Scholars
Faculty Mentor: Susan Freudzon

Black-tailed Prairie Dog (Cynomys ludovicianus) Aggression Above and Below Ground Studied via Observation and Underground Burrow Mapping
Undergraduate: Izabela Horzempa '19

Beginning in 2015, the Connecticut's Beardsley Zoo reported seeing high levels of aggression within their exhibit prairie dog colony. To better understand the reasons behind the aggression, we began documenting the colony's behavior and determined that most aggression occurred in a specific area rather than equally throughout the enclosure. Using a synthetic fogging machine to elucidate underground burrow connections, we discovered the possible existence of two separate burrow networks suggesting that the original colony had fractured into at least two separate groups or coteries. To confirm our suspicions, we surveyed the burrow networks using ground penetrating radar (GPR) which produces non-invasive, high resolution subsurface images. GPR results confirmed the existence of two separate burrow networks. Our observations and underground burrow maps suggest that this colony consists of two distinct coteries and that territorial food aggression between individuals of these different coteries was the principal cause of hostility. To test this hypothesis, we requested that zoo staff distribute the food within the enclosure so each of the two coteries had equal access to food. The redistribution of food according to coterie boundaries resulted in a sudden and dramatic decrease in aggression and fighting within the captive prairie dog colony.

Faculty Mentor: Dr. Ashley Byun

Does Feeling Your Joy Cause Me Pain?: Positive Empathy as a Source of Envy
Undergraduate: Emily Jones '18

Envy has been shown to be a common experience that has serious implications in the workplace, academic settings, as well as in one's personal life. As such, researchers have been interested in examining what factors contribute to experiencing it. This project examined an as-yet-unstudied factor—empathy for others' positive emotions. Since empathizing with another's positive emotions requires one to become acutely aware of how it would feel to be the one experiencing a positive event, it was hypothesized that engaging in positive empathy would increase one's likelihood of experiencing envy. To test this relationship, participants were prompted to think of a coworker that was similar to them. Then, they were asked to imagine overhearing a conversation in which this coworker expressed excitement about having been chosen for a promotion that they had both been competing for. Critically, half of the participants were instructed to imagine this scenario in an objective manner, while the other half were instructed to "feel along" with the emotions of their coworker in the imagined scenario as a way to encourage them to engage in positive empathy. Afterwards, all participants responded to a questionnaire asking about their feelings of envy in response to the scenario, and the levels of envy reported by each group were compared.

Scholarship: Mancini Fund
Faculty Mentor: Michael Andreychik

Investigating the Relationship between Nutrition, Stress, and Occupation
Undergraduate: Tracey Kamlani '18, Lydia Dupree '18, Kaley McMullen '19

Studies have demonstrated that individuals with high levels of occupational stress are at increased risk for metabolic diseases. Nutritional status and lifestyle habits may further contribute to an individual's stress response and overall health. The purpose of this ongoing research project is to investigate the relationship between nutrition, stress, and occupation. We hypothesize that individuals in emergency occupations (e.g. police officers, emergency healthcare workers) may have a less optimal nutrition status and increased stress levels as compared to individuals in non-emergency occupations. Nutritional status and stress were evaluated by measures of body composition, blood pressure, and lifestyle survey. On average, participants' body mass index (BMI), waist circumference, and body fat percentage were within a healthy range, regardless of occupation. However, individuals in emergency occupations tended to have higher body weight, BMI, waist circumference, and basal metabolic rates then individuals in non-emergency occupations. Emergency workers additionally had higher systolic and diastolic blood pressure. When surveyed, the lifestyle factors that participants found to be most stressful were fatigue and shift work relating to occupation. Our preliminary results indicate that occupation may be associated with more adverse markers of body composition and stress.

Faculty Mentor: Catherine Andersen

Deactivation of a Ruthenium(II) N-heterocyclic Carbene p-Cymene Complex during Transfer Hydrogenation Catalysis
Undergraduate: Rami Kharbouch '19

A ruthenium (II) N-heterocyclic carbene (NHC) complex was synthesized to investigate ligand dissociation as a possible deactivation pathway for the catalytic cycle for a transfer hydrogenation reaction. Diiodo (1,3-dimethylbenzimidazole-2-ylidene)(p-cymene) ruthenium(II) was synthesized for use as the catalytic species and was characterized using elemental analysis, NMR Spectrometry, electrospray mass spectrometry, UV-Visible spectroscopy, infrared spectroscopy, and single crystal X-ray diffraction. Using a proton NMR spectrometry, the catalytic hydrogen transfer from isopropanol to acetophenone was tracked. After one hour of reaction time, 94 % conversion of substrate to alcohol product was observed. The p-cymene complex was also observed, using proton NMR, to be 80% deactivated after one hour of reaction time. An ultraviolet-visible spectrum that is in excellent agreement with the experimental spectrum was computed using Gaussian calculations, which provides insight of the nature of the experimental absorptions.

Scholarship: Hardiman Scholars, Lawrence Program
Faculty Mentor: John R. Miecznikowski

Advanced Adhesive Bonding Application
Undergraduate: Sam Klippel '18, Jack Santoro '18, Thomas Moroski '18, Nicholas Caratelli '18

Lithography is the process of projecting an image from a reticle onto a wafer and etching that design into the wafer. It has many existing and emerging applications but is mainly used in the manufacturing of laptops, smartphones, tablets and other similar devices. The adhesive bonding present in lithography is vital to this process. As lithography improves, so does the speed and capability of the microchips created by this process. Recent advances in lithography have allowed manufacturers to feature components on microchips in the range of 22 nanometers. With features at this size, tolerance levels are at an all time low, making the adhesive bonding in the component even more important. The focus of this project will be to research and assess the recent improvements in adhesive application and assess the benefits of the manual vs automated manufacturing process. Another main part of this project will be in the design and analysis of the needle lead and the flexible holder for automation of bonds. This will involve analysis of the automated injection process to decide the ideal geometry of the needle and the development of a 1DOF mechatronic needle arm.

Faculty Mentor: Dr. Andrew Judge

Comparison of Caffeine and pH in Cold Versus Hot Brew Coffee via High Performance Liquid Chromatography
Undergraduates: Tyler Lyons '18, Jovelt Dorsainvil '19,

Caffeine is a central nervous stimulant of the methylxanthine class found in a number of plants and seeds. It is most widely consumed in coffee which quality is often perceived to be proportional to its caffeine content. Recently, new methods have been developed for coffee preparation, specifically, the cold brew method. In contrast to the standard hot brew, cold brew takes much longer to prepare, and is suspected to have different caffeine and pH levels because of this. Using high performance liquid chromatography, we aim to determine to relative caffeine content of hot brew coffee compared to cold brew coffee. Considering the caffeine molecule's sensitivity to high temperatures and the tendency of warm water's extraction abilities to plateau past a certain temperature, we hypothesize that the quantities of caffeine will be higher in cold brew coffee than in hot brew coffee. The results of this experiment will serve to inform coffee consumers purchases with regard to their taste and caffeine needs.

Scholarship: Hardiman
Faculty Mentor: Matthew Kubasik

The Impact of Self-presentation Style on People's Initial and Later Perceptions
Undergraduate: Hayley McGregor '18

People sometimes present themselves in a way that positively promotes their accomplishments and abilities ("I'm in great shape"), but other times they downplay themselves, for instance, by making humorous, self-deprecating remarks ("I'm in shape. Round is a shape, right?"), or negative, self-disparaging comments ("I'm so out of shape"). This study examined whether initial impressions for individuals vary as a function of the type of remarks they make about their accomplishments and abilities, and whether the nature of the remarks biased their later perceptions and memory in the direction of the remarks (e.g., remembering details about the self-disparaging person in an even more negative way). Participants (n=112) watched a video of an interview with a woman who either made several self-deprecating, self-disparaging, self-enhancing, or neutral remarks about herself, and then rated her on a number of attributes right after and again several days later, when their memory for the what she said and did was also tested. Results showed that the woman was viewed most favorably when she made several neutral remarks that neither exaggerated nor downplayed her abilities and accomplishments. Memory was not reliably distorted based on the nature of her remarks but performance was low overall.

Faculty Mentor: Linda Henkel

Magnetic Cell Sorting Chamber
Undergraduate: Kerry McHugh '18, Sarah Niro '18, Joseph Taggart '18, Jordan Emsley '18

An experimental cancer treatment, Magnetic Hyperthermia, is the process of injecting nanoparticles susceptible to magnetization into a tumor. An alternating magnetic field is applied to these nanoparticles, causing their magnetic field to switch direction quickly. With this change, energy is lost in the form of heat. This heat kills the tissue surrounding the nanoparticles, leaving healthy tissue undamaged. This allows for a noninvasive treatment option for tumors. This process also aids in chemotherapy treatment, as the medicine used can destroy heated tissue better than regular tissue. Currently, when the nanomaterial is added, certain cells absorb more magnetic nanoparticles than others. Research is necessary to learn more about this difference in concentration. To study this phenomenon, the cells must be separated. This project will be completed in close conjunction with developing research in nanoparticles and cancer treatment. The overall goal of the project is to separate cells based upon their concentration of magnetic nanoparticles and keep them viable for further research. By doing this, researchers will be able to evaluate why cells absorb certain amounts of magnetic nanoparticles. The device is expected to perform these tasks consistently, such that it can be used throughout the refinement of the magnetic hyperthermia process.

Faculty Mentor: Dr. Susan Freudzon

How Editing Photos Can Edit Our Memories
Undergraduate: Anna Milliken '18

Photo taking has become a ubiquitous part of everyday life. However, what impact does editing those photos have on people's memory for the original event and what they did to their photos? This study examined the influence of different types of photo editing styles on people's memory. 54 subjects took photos of different scenes, and while reviewing the photos later cropped out an object from some of the photos, applied a black-and-white filter to others, and just looked at the remaining. Several days later, their memory was tested. Results showed that memory for the objects and colors in the scenes did not differ when people had cropped that object from their photo, changed the color of the object in their photo, or just looked at the photo without editing it. They were less accurate at remembering how they edited the photo when they applied the color-changing filter than when they cropped it. For subjects who self-reported paying attention the majority of the time during the photo-taking task, memory for the content of their photos was lower when they edited the photo by applying the color-change filter than when they actually cropped the object out or did not edit the photo. Taken together, this suggests that engaging in a relatively simple and uneventful act such as hitting a button and changing the color of the photo can have consequences for what people remember.

Scholarship: Hardiman
Faculty Mentor: Dr. Linda A. Henkel

Label-free Computational Staining for Cancer Histopathology
Undergraduate: Phuc Nguyen '21, Run Li '18, Xin Xie '20, Mahammad Camara '19,

Cancer diagnosis currently depends on time-consuming histopathology processes and subjective evaluations by pathologists. We present a new method of computational staining in place of the traditional hematoxylin and eosin (HE) staining. This method is derived from our recently developed chemometric fluorescence microscopic imaging on unstained specimens and it reduces the total required time significantly. Based on our preliminary findings, our computational stained images were able to visually differentiate specific cell properties, such as cellular metabolism of NADH, FAD, as well as protein production of tryptophan and elastin. The key chromophores NADH, FAD, tryptophan and elastin are encoded in red, green, gray and yellow respectively, with their intensities proportional to the physical concentration. In the preliminary study of seven different states of non-cancerous to cancerous tissues from 18 patients, we observed that cancer is associated with higher concentrations of NADH and tryptophan and less production of FAD. Computationally stained images generated from unstained histological slides with chemometric endogenous fluorescence microscopy not only share the morphology similar to that from H&E stained images but also indicate the biochemical alterations due to cancer. It paves the first step to translate chemometric fluorescence microscopic imaging into clinics.

Faculty Mentor: Min Xu

Improvements to Synthesizing Radioactive-Resistant Wavelength Shifting Optical Fibers
Undergraduates: John Nikas '18, Edward Wenzel '20

Wavelength shifting (WLS) fibers are photoflourescent materials that absorb high frequency photons and emit lower energy photons. Optical fibers that are developed with a wavelength shifter can be used to collect scintillation light in particle detectors. However, when optic fibers are exposed to ionizing radiation, they undergo damage. Particle detection experiments conducted in the compact muon solenoid (CMS) at CERN's Large Hadron Collider require fibers that are radioactive resistant (radhard) but retain their optical properties. Most of the research on WLS fibers in the literature focuses on maximizing resolution in low-light conditions or on the use of orthogonal frequency division multiplexing (OFDM) format for broadband optical access networks. This study focused on making improvements to the process of synthesizing optical fibers. Fiber models were prepared with Teflon AF and a variety of silicon fibers and were tested using toluene, cyclohexane, and 3 hydroxyflavone (3HF) chemical combinations. A combination of injection and coating methods was used in fiber construction. Completed fiber prototypes were tested using data from UV light, attenuation, and black box radiation tests. Our research found toluene mixed with 3HF to be most successful in the Teflon AF fibers. The most promising fiber prototypes were sent to our collaborators for further testing.

Faculty Mentor: David Winn

The Prevalence of Babesia Species in Pennsylvania Elk
Undergraduate: Allison Peeney '19

Ticks are a group of parasitic arachnids that consume blood from other hosts. They feed for approximately 24 - 48 hours and disease transmission can occur when they regurgitate the aqueous components of blood. Recently, there have been increases in tickborne illnesses, tick populations, tick activity in winter, and the expansion of ticks to higher altitudes. These problems are further exacerbated by climate change. Besides their increased prevalence, ticks also are a threat due to their ability to feed on a variety of hosts and to use multiple hosts during one bloodmeal. Many tickborne pathogens cause disease in humans, such as babesiosis. Babeosiosis, a disease caused by Babesia species, can also occur in elk. Babesia is carried by deer ticks (Ixodes scapularis) and frequently transmitted with other pathogens such as Anaplasma phagocytophilum and Borrelia burgdorferi (Lyme disease). The purpose of this project was to determine the prevalence of Babesia species in Pennsylvania elk and to design an assay for detecting Babesia species in these samples. As tick populations are increasing, monitoring of Babesia and other tickborne pathogens is essential for wildlife preservation, including elk, as well as for control and prevention of tickborne illnesses in humans. Additionally, controlling these pathogens will mitigate their transmission to other animals.

Faculty Mentor: Anita Fernandez

Data and AI-Driven Dashboard for Commodities Trading
Undergraduates: Bradley Nordstrom '18, Lauren O'Malley '18, John Knight ,18

There are many market inputs that affect the prices of energy commodities, so tracking the most actively used commodities like oil is vitally important for companies in this industry. The development of our data and AI-driven dashboard will be useful by allowing users and companies to easily study current and future trades on a daily basis. A heatmap with all relevant information readily available is important for energy companies because it enables them to plan and research methods to save and earn more money within their daily operations. The artificial intelligence implemented in our data-driven dashboard will offer an efficient and personalized experience for the client by analyzing energy news items like web scrapers, price scanners, Bloomberg news feeds, and Reuters news feeds; the algorithm we develop include some logic found in Natural Language Processing in association with these datasets. We will be primarily focused on the dashboard's software and the logic used when processing vast datasets about energy news. The AI we plan to implement will be able to identify clusters and patterns within the information it analyzes, i.e., dips in the energy marketplace over time or similarities between two energy commodities.

Faculty Mentor: Dr. Adrian Rusu

Automated Gearbox
Undergraduate: Nick Panara '18, Matthew Lee '18, Matthew Mark '18, Ryan Fishbaugh '18, Marco Giordani '18

Gearboxes are used in machines over a vast number of industries. They are designed to transmit motion, torque, and change the direction of a force. Gearbox design is an iterative process where the designer must select the appropriate shafts and gears that transmit the necessary torque without failure. The goal of this project is to automate this process, so that the designer only must provide the program, information about the input and output requirements such as gear ratio, speed, torque, and space available. Our program is aimed to simplify and reduce the time taken to design a gearbox. The developed tool will be able to automatically recommend the appropriate shafts and gears that satisfy the requirements. Then from these values the program will then select the gear or shaft size from a previously created database with commercially available sizes. Once selected, the shafts and gears will automatically undergo a stress analysis to check for failure. Upon determination of the correct sizes for the shafts and gears, the tool will generate a SolidWorks assembly file of the gearbox. The program will select the shafts and gears from a previously created part library of the commercially available sizes. Finally, the tool will convert the SolidWorks assembly model into a file format that can be 3D printed.

Faculty Mentor: Sriharsha Srinivas Sundarram

An Exchange Reaction Based on an Inverse Electron Demand Diels Alder (iEDDA) Cycloaddition
Undergraduates: Raquel Reilly '20, Daniel Gatazka '18

There are a wealth of bioorthogonal ligation and cleavage reactions in the field of Chemical Biology. However, relatively few exchange reactions have been developed which can ligate two species while simultaneously ejecting a carbogenic portion from one of the ligating partners. Exchange reactions of this form have important applications in Chemical Biology. For example, Dr. Van Dyke's group previously modified the Staudinger ligation to function as an exchange reaction. The result was a small molecule Capture-Tag-Release (CTR) probe that could covalently label native enzymes without altering their intrinsic function. However, its reliance on the Staudinger phosphine resulted in a reaction that was air sensitive and would likely exhibit poor cellular uptake, limiting its utility in living systems. Herein we report a new exchange reaction, based on an inverse-electron-demand Diels-Alder (iEDDA) cycloaddition. In our proof-of-principle exchange reaction, a carbogenic moiety is transferred from a strained alkene to a tetrazene. This new reaction possesses potential as a second generation CTR probe that will help expand the toolbox of chemical biologists.

Scholarship: Hardiman Scholars, Faculty Student Collaborative Fund
Faculty Mentor: Aaron Van Dyke

Nesting Sex Ratio in Magellanic Penguin Chicks from Punta Tombo, Argentina.
Undergraduate: Nicholas Ryan '20

This project examines, among other things, the differential survivorship between male and female Magellanic penguins chicks at a colony subjected to heavy tourism disturbance in Argentina. Sex of chicks is determined through the extraction of DNA from blood samples and then running PCR reactions with sex-specific primers which identify males from females. Data collected from nest survivorship can then be examined in relation to both sex of chicks, as well as location in the colony (i.e., areas with and without tourists). This work is in association with other studies that will examine stress effects of tourists on chicks, as part of a long term study of Magellanic penguins on our lab.

Faculty Mentor: Dr. Brian Walker

Locomotor performance and muscle physiology of tautog (Tautoga onitis)
Undergraduate: Caroline Rzucidlo '18

Residing in the North-West Atlantic, tautog are one of the northern most species in the family Labridae. As water temperatures cool tautog migrate offshore to their wintering habitats where temperature is constant in deep water. Previous work with cunner, a related species, demonstrated that muscle function was inhibited at cold temperatures. We studied the impact of acclimation temperature on steady swimming and pectoral fin muscle function in tautog. We hypothesized that muscle acclimated at cold temperatures would produce less power than muscle acclimated at warm temperatures. Additionally, we hypothesized that twitch contraction and relaxation times would increase with decreasing temperature. To address these hypotheses, we acclimated tautog at each temperature for a minimum of two weeks. We performed steady swimming experiments, then removed the abductor superficialis and performed muscle kinetic tests and standard workloop protocols. Fish acclimated at warm temperatures were able to sustain higher swimming velocities. At cold temperatures the pectoral fin abductor muscles were slower to contract and relax, displaying inhibited muscle function. Additionally, power output increased with increasing temperature. Decreased swimming and muscle performance suggests that tautog migrate offshore to a thermally constant environment, avoiding further cooling in inshore habitats.

Scholarship: Lawrence Program
Faculty Mentor: Shannon Gerry

Glucose Biosensing Integrating Aerogel Components
Undergraduate: Dana Saad '18, Catharine Brady '18

A biosensor is a type of analytical device that uses a biological component as part of the detection method and has a broad range of applications across many areas including medical and environmental testing. An indirect glucose detecting electrochemical biosensor uses the enzyme glucose oxidase and has been highly studied because glucose levels must be monitored in the treatment of diabetes. Due to the extensive amounts of research done on the glucose/glucose oxidase biosensing system, it is a great model to learn more about how the structure of a biosensor relates to and affects the performance and function of it. Highly porous, three-dimensional aerogels have the potential to add surface area to glucose biosensors and enhance the sensing response. We will present methods investigated to immobilize glucose oxidase onto aerogels and how these methods affect the electrochemical signal response through cyclic voltammetry.

Scholarship: Mancini Fund
Faculty Mentor: Amanda Harper-Leatherman

Rumination Mediates the Relationship Between Social Anxiety and Suicide Ideation in African Americans
Undergraduate: Chelsea Salvatore '19, Andriana Goodchild '19

Suicide is currently the third leading cause of death among African American young adults (CDC, 2018). Past research has demonstrated that both social anxiety symptoms (Thibodeau et al., 2013) and rumination (repetitively thinking about problems or negative experiences; Nolen-Hoeksema, 2000) are risk factors for suicide. Although there is evidence of a relationship between these variables and suicide ideation, no study has examined them simultaneously in a mediation model, specifically in a sample of African Americans. Thus, the aim of the current study was to examine rumination as a mediator of the relationship between social anxiety symptoms and suicide ideation among African Americans. It was hypothesized that rumination would significantly mediate the relationship between social anxiety symptoms and suicide ideation. Participants included 52 African American college students. Results of the mediation analysis using 5,000 bootstrapping samples found that rumination significantly mediated the relationship between social anxiety symptoms and suicide ideation (95% BC CI of .0006 to .0153), supporting the hypothesis. These results imply that for African Americans, an increase in social anxiety symptoms could lead to an increase in thinking about negative experiences, which in turn could lead to increased thoughts of suicide.

Faculty Mentor: David Hollingsworth

Analysis of Road Strike Incidents on the BR-101 Highway through Serra do Mar National Park
Undergraduates: Teresa Sauer '20, Katherine Biardi '19, Robert Farrell '18, Joseph Sarni '18

The Serra do Mar National Park, Brazil is one of the largest and most conserved remnants of the Atlantic Rainforest, one of the most biologically diverse regions on earth. Although more than 80% of its territory is currently under government protection, the region's fauna remains highly susceptible to threats posed by man-made structures such as roads and powerlines. The BR-101 is a major trans-coastal highway which runs through the Serra do Mar Park. From 2004-2016, the wildlife conservation group Profauna collected data on the number and types of road strikes along 55 km of the BR-101. We analyzed the frequency and location of roadkill incidents data in order to identify any locational or seasonal patterns in roadkill frequency, as well as which species were most at risk to being maimed or killed by traffic. Application of these findings will aid in the development and implementation of mitigation strategies such the establishment of deterrence structures along the BR-101 at roadkill hotspots during peak times of animal activity and migration.

Faculty Mentor: Ashley Byun

Bird Conservation In Ubatuba- Decreasing Bird Death Due to Motor Vehicle Incident across BR101 Highway
Undergraduates: Jennifer Schwartz '18, Sophia Fagan '19, John Cahill '19

The Brazilian Atlantic Rainforest is one of most biodiverse regions on Earth. Although extensive deforestation over the past 500 years, has left only 8.5% of the original forest intact, the Serra do Mar has largely remained insulated from large scale logging and agriculture due to its rugged, mountainous terrain. As such, the region is home to many endangered and endemic animal species and has been under government protection since the late 1970's. The BR-101 is a major transcoastal highway which runs directly through the Serra do Mar. As the main transportation route for both recreational and commercial traffic, it poses a serious threat to the area's wildlife. Birds are a common casualty as they swoop down from the mountains to low lying vegetation along the roadside's cliffs. With over 500 species of birds in the Serra do Mar, a quarter of which are endemic and/or endangered, developing strategies to mitigate these bird strikes is essential for bird conservation in the region. Together with the wildlife conservation group Profauna, we set out to develop and test different strategies which would alter bird flight patterns and potentially be useful deterrents along Bird type, flight pattern, feeding habits, and weather conditions were recorded in relation to the varying structure set-ups.

Faculty Mentor: Ashley Byun

Using Traditional Knowledge of Local Communities to Locate and Document the Presence of the Southern Muriqui in the Serra Do Mar, Brazil
Undergraduates: Allison Sloan '19, Aura Agudelo Rivera '18, Michelle Kabel '19, Alexander Gaito '18

With an estimated 1500 individuals left in the Brazilian Atlantic Rainforest, the southern muriqui (Brachyteles arachnoides) is an endangered animal whose current distribution and population status are still poorly known. In the Serra do Mar, one of the remaining areas of intact rainforest, the presence of rugged terrain restricts human access thus only a handful of documented muriqui sightings exist. Traditional human communities have gained a vast amount of knowledge about local animals through generations of living in close association with the rainforest. Using traditional knowledge can be valuable to scientific projects by providing vital information about endangered animals. To document community knowledge on the southern muriqui, in January 2018, we, along with the wildlife conservation group Profauna, conducted a series of interviews with residents of three traditional communities in the Serra do Mar as part of the service learning course Field Experiences in Brazil (BI 319). From these interviews we collected locations of muriqui sightings, developed a partial seasonal foraging route, and collected information about a new muriqui morph, currently unknown to science. This data will be used to plan future expeditions into the Serra do Mar, which will hopefully lead to the best conservation efforts to put forth in order to help foster the remaining southern muriqui.

Scholarship: Hulseman Fund for Global Experiential Learning
Faculty Mentor: Ashley Byun

The Amount of Resveratrol Found in Three Different Wines
Undergraduates: Julia Smith '18, Caitlyn Zarra '19

Resveratrol is an antioxidant that is commonly found in fruits, and the wines made from those fruits. Antioxidant therapy is used to treat patients with cancers, to inhibit tumor growth and proliferation. We will test three wines to determine the amount of resveratrol present. Pinot noir, pinot grigio, and blueberry wine will be compared to a standard resveratrol. High performance liquid chromatography and gas chromatography mass spectrometry will be used to perform such methods. Based on research, we are expecting blueberry wine will have the greatest resveratrol content, followed by pinot noir, then pinot grigio. Although they will not be used further in this experiment, the results can be used to possibly provide another option for antioxidant therapy.

Faculty Mentor: Matthew Kubasik

Venom Resistance Proteins in Squirrel Species
Undergraduate: Michael Spillane '19

The long term goal of this research is to analyze the proteins found within the blood of certain squirrel species that provide resistances to snake venom. Achieving a better understanding of this process could provide medical experts with more tools to combat snake bites on patients that cannot receive antivenom due to strong allergic reactions. In order to determine what proteins are within the blood of these squirrel species, the Matrix-Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometry, or MALDI-TOF MS, instrument is being utilized. This instrument is capable of ionizing serum samples which then travel through a drift space until the ionized molecules reach a detector that reads the ion's time of flight. Based on this information, the instrument can then provide the molecular weight in Daltons of the ions traveling through the drift space. Currently, this project is working on using the MALDI as a possible avenue of analyzing the proteins within blood serum samples of numerous squirrel species that have a coevolutionary arms race with venomous snake species.

Faculty Mentor: James Biardi

Synthesis and Characterization of 1,2-Dithiolane Modified Self-Assembling Peptides
Undergraduate: Kaitlyn Stephens '18, Ruben Neves'17

One strategy to increase the diversity of peptide-based structures is to incorporate 1,2-dithiolane moieties to self-assembling peptides. We report on the synthesis of a dithiolane modified self-assembling peptide and the characterization of the resulting supramolecular structure. The synthesis method utilizes solid-phase peptide synthesis with on-resin coupling of the dithiolane precursor molecule, followed by microwave-assisted thioacetal deprotection, before cleavage from the resin, to yield the 1,2-dithiolane modified peptide. After HPLC purification and MALDI-TOF confirmation, characterization of the peptide assembly was accomplished using Fourier-Transform infrared spectroscopy (FT-IR), circular dichroism spectroscopy (CD), and transmission electron microscopy (TEM). Our research confirms that our 1,2-dithiolane modified peptide self-assemblies into β-sheet rich supramolecular structures.

Scholarship: Faculty Student Collaborative Fund
Faculty Mentor: Jillian Smith-Carpenter

The Power of Perception: Can People's Perceptions of Their Partner's Empathy Affect Relationship Quality Over Time?
Undergraduate: Kaitlyn Tatulli '18

Recent research on relationships has shown that perceptions of the extent to which one's partner empathizes with one's negative vs. positive emotions are each independently related to relationship quality (Andreychik, 2018). But, to date, no research has examined whether perceptions of partners' levels of negative and positive empathy exert long-term effects on relationships. The present research will provide evidence to address this deficit by examining how individuals' perceptions of their partners' levels of negative and positive empathy affect relationship quality over time. 62 couples received three surveys over three months, which included a batery of measures. The results did not show a strong or consistent relationship between a partner's perceptions of their partner's empathy levels and their relationship satisfaction over three months. However, the results do suggest that positive empathy is related to variables like intimacy, capitalization, and sympathy and that negative empathy is related to these variables less so.

Scholarship: Lawrence Program
Faculty Mentor: Dr. Michael Andreychik

Dynein and MEL-28 Coordinately Contribute to Fertility in the Nematode Worm Caenorhabditis elegans.
Undergraduate: Gabriela Vida '18

Most biological processes, including fertility, are controlled by multiple gene products that act together. We are interested in understanding genetic interactions that affect fertility in the nematode worm Caenorhabditis elegans. Specifically we have been studying dhc-1, which encodes a component of the molecular motor dynein, and mel-28, which encodes a nuclear pore component. Although mel-28 and dhc-1 single mutants have a normal brood size, mel-28;dhc-1 double mutants show severely reduced fertility, suggesting that normally mel-28 and dhc-1 act cooperatively to promote fertility. To better understand why dhc-1;mel-28 double mutants have reduced fertility, we have been analyzing the gonads of the double mutants using DIC imaging and immunolocalizations. In normal animals the proximal gonad consists of oocytes arranged in a linear fashion according to their maturity, with the most mature oocyte closest to the spermatheca. mel-28;dhc-1 double mutants show a severe oocyte disorganization in the proximal gonad. To characterize this, we have been studying markers of mature and immature oocytes in mutants and in normal worms. In the dhc-1;mel-28 double mutant immature oocytes are often found at inappropriate positions, suggesting that dynein and MEL-28 act together to regulate the timing of oocyte maturation.

Faculty Advisor: Anita Fernandez

Identifying Elliptic Islands in Angled Mushroom Billiards
Undergraduate: Emma Waters '18, Sally Franz '18

Mathematical billiards are important models of dynamical systems from statistical mechanics. This project concerns a class of billiard tables called mushroom billiards, which exhibit a wide variety of dynamical behavior. We study the dependence of features of the phase space, such as the existence of ergodic components and elliptic islands, on certain parameters which determine the geometry of the billiard table. We present a classification of the parameter space according to stable periodic orbits for an important class of angled mushroom billiards. This research was conducted at Fairfield University during the summer of 2017 with support from the National Science Foundation.

Faculty Mentor: Mark Demers

Effects of Temperature on the Escape Response of Cunner
Undergraduate: Caroline Young '18

Cunner (Tautogolabrus adspersus) are a temperate species from the family Labridae that inhabit the Western Atlantic. Therefore, this species experiences temperatures ranging from 0 °C to 25 °C. Once temperatures drop below 10 °C in Long Island Sound, cunner find shelter to enter into extended torpor. It is not known how temperature might impact the escape response of cunner and thus influence hibernation. Previous studies have shown that acclimation to low temperatures inhibits locomotor muscle, which significantly lowers steady swimming performance. We examined the impact of temperature on the fast-start escape response of cunner. We hypothesized that cunner will exhibit a faster escape response at higher temperatures. Four predator escape responses were recorded at 250 frames s-1 for six cunner at each temperature (20 °C, 15 °C, 10 °C, and 5 °C). We compared peak, minimum, and average center of mass (COM) velocities and accelerations among temperatures. Average COM velocity was faster at 20 °C than 10 °C or 15 °C. Similarly, peak COM velocity and acceleration were faster at 20 °C than at 10 °C. These findings further support our observations that swimming performance is inhibited at lowered temperatures. We expect that rising ocean temperatures will shift the range of this species and impact swimming and torpor behaviors.

Scholarship: Femia Science Endowment
Faculty Mentor: Shannon Gerry

WIC Works: Food Package Revisions Neutralize Differences in Dietary Intake Between Participants and Nonparticipants
Undergraduate: Meghan C. Zimmer '18

Objective: To assess the impact of the 2009 WIC food package revisions on the consumption of targeted food items and key nutrients of concern in a nationally-representative sample of US children and women. Methods: Data from children ages 2-5 and women 12y+ who participated in the 2005-2008 and 2011-2014 National Health and Nutrition Examination Survey (NHANES) were used for this study. Dietary intake was collected by the NHANES using 24h recalls. All data were analyzed using SAS 9.4. Results: Prior to the 2009 WIC revisions, children in households receiving WIC benefits consumed less red and orange vegetables, more starchy vegetables, more fruit juice as well as less calcium, less zinc, and more potassium than non-WIC participants; no difference was observed after the policy change. Also, WIC children consumed more legumes, whole grains, and vitamin C than nonparticipants after the revisions. Similar trends were observed with women. WIC women consumed less dark green vegetables and cheese than nonparticipants, but this difference was not observed after the policy change. Conclusions: The WIC food package revisions neutralized differences in dietary intake and nutrient distribution between WIC participants and nonparticipants. The mostly positive influence of the cost-neutral WIC revisions suggests that policy interventions in WIC are effective at the population-level.

Scholarships: CAS Endowment, Hardiman Scholars, Santella Health Studies Scholarship
Faculty Mentor: Jacqueline Vernarelli

Creation of Bandpass Filter
Undergraduate: Clarensky Benoit '19

This project constitutes the creation of a band-pass filter. A band-pass filter is used to filter out unwanted frequencies from a certain signal within a specific band depending on the application. In this project, student analyzed different types of electrical filters and was given a band within which to create band-pass filter. Band-pass filters are widely used in electronics as well as telecommunication. This project requires substantial knowledge in Electrical Engineering as it encompasses an extensive understanding of electrical circuits.

Scholarship: Corrigan Scholars Fund
Faculty Mentor: Uma Balaji

Micro Bio Reactor Array via 3D Printing and Solid State Foaming
Undergraduate: Gabriella Borea '19, Gabriella D'Angelo '19

For this research project, we are focusing on building three-dimensional porous polymers and applying them to the field of tissue scaffolds. In order to create these porous polymers , a three-dimensional (3D) printer is used to create the structure of our choosing. In order to print the 3D samples, we first create a design by using SolidWorks. SolidWorks is a computer aided design (CAD) program, which focuses on solid modeling, that runs on Microsoft Windows. More specifically, it uses a parametric feature style, in order to create models and assemblies necessary for a specific project. The parametric feature style it utilizes is one that allows the designer to choose the preferable constraints and dimensions necessary, in the shape and form of their choosing. Then, we analyze the dimensions of the piece and determine what changes need to be altered in order for it to fit our overall design. Some of the problems that need to be corrected in the current model are the buckling of the spring mechanism and the bending of the plastic rods when they rub against the cam mechanism. Once this design is printed, the sample is subjected to a process known as solid state foaming which generates the porous structure in the 3D printed sample. The experimental parameters will be varied for the foaming process to obtain different porous structures.

Scholarship: Lawrence Program
Faculty Mentor: Sriharsha Srinivas Sundarram

Polyetherimide Nanocomposite Foams
Undergraduates: Gabriella D'Angelo '19, Gabriella Borea '19

For this research project, we are focusing on creating specific polymer nanocomposites through the use of ultrasonic techniques, which will then undergo a solid state foaming process in order to generate porous structures for analysis. More specifically, the ultrasonic technique will be used to uniformly disperse a multi-walled carbon nanotube into PEI nanocomposites. Electronic microscope scanning will be used in order to check that this dispersion is distributed uniformly throughout the PEI nanocomposite. Once the ultrasonic mixing technique and the solid state foaming processes are complete, we will analyze our results by observing the various dimensions and pores throughput each model. Adjustments will be made accordingly. We will perform this process under various conditions and analyze and compare the results each time. The equipment required for our project is housed in the research lab of our mentor Dr. Sundarram and Materials Characterization Lab at the School of Engineering.

Scholarship: Lawrence Program
Faculty Mentor: Dr. Sriharsha Srinivas Sundarram

Solar Powered Desalination System
Undergraduate: Christina Ficaro '18, Nicholas DeBiase '18, Kacper Laska '18, Run Li '18, Ryan McGovern '18

Water, the foundation of humanity's livelihood and the quench to our thirst, is exceedingly finite, yet abundantly present. The discrepancy between the amounts of potable water and natural water present on our planet is immense. To provide for ourselves, we must treat the limited amount of water we receive from freshwater sources or desalinate water from our ever-abundant oceans. Though simple for those living in wealthy countries, water purification proves to be inaccessible for many living in impoverished and rural areas. Our work will focus on the research and development of a robust, portable, solar desalination system that will produce safe drinking water and serve as a potential solution for the ever-present water crisis. For this project, we will focus on the region of East Africa, potentially Tanzania, where potable water is significantly limited. We will utilize a sustainable power source by harnessing the sun's rays to evaporate and desalinate the water. In a secondary process, ultraviolet light will then eliminate any remaining bacteria. Our goal for the device is to output up to a liter of drinking water per every two to three hours while keeping the cost of the device within a hundred dollars for humanitarian feasibility.

Scholarship: Hardiman Scholars
Faculty Mentor: Mehdi Safari

STEM of Electric Guitar Building
Undergraduate: Kathryn Higgins '18, Marydjina Barionnette '18, Madison Roberts '19, Carlos Urena '18, Maverick Ruiz '18, Phuc Nguyen '21, Anthony Pope '18, Patrick Heeks '18, John O'Neill '18, Ryan McGovern '18, Nicholas Debiase '18, Christian Adamczyk '18, Nicholas Caratelli '18, John Crowley '18, Ryan Ferreira '18

Through the EG 60 STEM Guitar course, each student in the group has completed design and fabrication of their own unique solid body electric guitar. This course examines the design elements, manufacturing and assembly of solid-body electric guitars. Science, Technology, Engineering & Mathematics (STEM) concepts that relate directly to guitars help students make an applied learning connection. We reviewed wood species and the environment, guitar headstock design features, chemistry of finishes, math applications in a guitar, physical science aspects of the guitar such as mechanical systems, concepts of sound waves, string tension, fretboard layout, intonation, and electronics. Each student constructed a functional, playable, telecaster-style electric guitar, with bolt on neck, 25 ½" scale length, and dual humbucker pick-ups. They also solder the passive tuning electronics, and an active mini-amplifier. Fretboards are rosewood on maple necks. Bodies are CNC-machined poplar, or maple and mahogany. Students cut, route, sand, and shape the bodies and headstocks. The guitars incorporate various finishes: stains, enamel paints, true oil, and swirl-dipped paint. Many incorporate unique fabrication techniques and materials including: metal casting, hand-carved sculptural elements, wood burning, laser etching, etc.

Faculty Mentor: Ryan Munden

Air Quality Visualization Application
Undergraduates: Matthew Richardson '18, Brian Walsh '18, Peter Julian '18, Nicole Kwasnaza '18

When one thinks of deadly forces of nature, rarely do they consider air quality. Yet, according to the World Health Organization, poor air quality kills 3-5 million people annually. The cause for the majority of these fatalities can be linked to two issues: inadequate education, and a lack of government-based funding and research on the topic. Most existing air quality alerts only monitor the Air Quality Index (AQI). This is often filled with data that is too complex for most meteorologists to interpret, meaning that the everyday person (who is impacted the most) has a very limited understanding of it. Developing a new system to monitor and relay air quality alerts to people via computers, tablets and mobile devices will greatly reduce the number of deaths each year related to heavy air pollution, especially helping those people with breathing disorders. The application will involve analyzing data currently used to determine the AQI. It will collect real-time information from air quality sensors around the world and proceed to display the collected data in an easy-to-understand graphical or chart-based format. People will be able to easily inquire about hyper-accurate air quality alerts and statistics, based on their selected location. The project will conclude once the fatal threat of poor air quality is reduced by our live detection system which is no more than a click away.

Scholarship: Hardiman Scholars
Faculty Mentor: Adrian Rusu

Land Maverick
Undergraduates: John O'Neill '18, Ryan Ferreira '18, Jose Osorio '18

Soil sampling in the agriculture industry is the process by which the conditions of soils are determined via the manual testing of nutrient content. The intent is to test the soil's integrity for areas of nutrient strength or deficiency; all information which can aid the farmer in better planting crops. It is fact however, that most fields are large; therefore, current soil testing procedures can be time and resource-consuming. It is possible that through autonomous methods then, capable of conducting basic soil testing operations, that time, cost, and efficiency in farming techniques can be improved. The aim of this project is to develop a semi-automated platform that will augment the soil testing process. A modular vehicle with the ability to sustain off-the-shelf components, while capable of performing over varied terrain will be designed. Probes and sensors that can take and record soil data such as temperature, moisture, and nutrient content will be tested and implemented. Integrated software that can collect as well as analyze and synthesize data will be explored and developed. The ultimate objective is to provide usable interpretation of this data to the user via a map or other means so that better farming strategies can be developed.

Scholarship: Hardiman Scholars
Faculty Mentor: Dr. R. Munden

Measuring behavioral changes in the valproic acid rat model of autism following vitamin A diet supplementation
Undergraduates: Aura Agudelo Rivera '18, Nicole LoCurto '18

Abstract: Autism Spectrum Disorder (ASD) is characterized by stereotyped behaviors and persistent deficits in social interactions and communication. Currently, one in sixty-eight children in the United States is diagnosed with ASD, and in a recent clinical study, vitamin A deficiency was reported in 78% of ASD patients. However, the specific effects of Vitamin A on ASD have not been fully examined. The present study investigates whether vitamin A supplementation in food can alleviate ASD symptoms using an animal model for autism. Four pregnant Long Evan dams were injected with valproic acid (VPA; 600 mg/kg) on gestational day 12.5 to induce ASD-like symptoms in pups. Control dams (n=2) were injected with a similar volume of saline on the same day. After weaning, male pups were assigned to four treatment groups: VPA-Vit A (n=10), VPA-Std (n=10), Saline-Std (n=6), and Saline-Vit A A (n=4); receiving a standard diet (Std) or a diet rich in vitamin A (VitA). Several behavioral tests were performed including open field and elevated plus maze to measure anxiety, and sociability, prosocial, and copulation tests to measure social behaviors. Preliminary data analysis suggests no significant differences between groups, however trends in the data are seen. This research has important implications for ASD and may provide additional evidence for a link between gut microbiota and behavior.

Faculty Mentor: Dr. Harding

Dynactin is Required for Proper Sperm Function in the Nematode Worm C. Elegans
Undergraduate: Aura Agudelo Rivera '18

Abstract: Animal fertility requires the coordinated activities of many genes. dnc-1 encodes the large subunit of dynactin, a multimolecular complex that couples molecular motors with their cargo. We have been using the nematode worm C. elegans to better understand the role of dnc-1 in fertility. Most C. elegans worms are hermaphrodites, which means they produce both sperm and eggs and undergo self-fertilization to produce progeny. C. elegans males pass sperm to hermaphrodites when mating, but they can't lay their own eggs. dnc-1 single mutants have reduced fertility, and reciprocal crosses suggest that impaired sperm function causes this problem. Defects to mel-28, a gene required for nuclear pore function, rescues this low-fertility phenotype. To test dnc-1 mutant sperm, we performed a sperm competition assay. When normal hermaphrodites mate with normal males, almost 100% of the offspring are sired by the male parent because male sperm outcompete hermaphrodite sperm. However, when we mated dnc-1 mutant males with normal hermaphrodites, only 30% of the offspring were fathered by the male, suggesting that the dnc-1 mutant male sperm are no longer as capable of accessing the oocytes. To test if defects to mel-28 rescue the male sperm competition defect, we are currently performing sperm competition tests by crossing mel-28;dnc-1 double mutant males to normal hermaphrodites.

Faculty Mentor: Dr. Anita Fernandez

Uric Acid Biosensing Integrating Aerogel Components
Undergraduate: Catharine Brady '18, Dana Saad '18

A biosensor is a type of analytical device that uses a biological component as part of the detection method and has a broad range of applications across many areas including medical and environmental testing. Abnormal levels of uric acid have been related to many diseases including obesity, diabetes, high blood pressure, kidney disease, and heart disease, making uric acid a relevant biological target to use for studies of structure, performance, and function of biosensors. Previous research has used β-cyclodextrin in a non-enzymatic electrochemical biosensing scheme to detect uric acid. Highly porous, three-dimensional aerogels have the potential to add surface area to these biosensors and to enhance the sensing response. We will present methods to incorporate β-cyclodextrin into aerogels and will present the effects of these aerogels on the detection of uric acid.

Scholarship: Lawrence Program, Mancini Fund
Faculty Mentor: Amanda Harper-Leatherman

Your Notes