SIGMA XI

THE SCIENTIFIC RESEARCH SOCIETY

16th Annual Poster Presentation

WEDNESDAY, APRIL 20, 2016

Fairfield UNIVERSITY

Identification of Putative Transcription Factors and the Evolution of the Peroxiredoxin Gene Family
Bryan Bystrianyk '16
Abstract: The Peroxiredoxin (PRDX) gene family controls the production of antioxidant enzymes, which regulate peroxide levels and mediate signal transduction in cells. Peroxiredoxins are also important for their role as tumor suppressors, and overexpression of certain members of this family has been noted in certain human cancers. The peroxiredoxin family consists of six genes: PRDX1 – PRDX6. Much research has been focused on the proteins themselves and the DNA sequences for these genes but the evolution of these genes and how they are regulated has been less researched. In this study, we used bioinformatics tools to identify transcription-binding sites and putative transcription factors for each member of the PRDX family. We also generated a maximum likelihood phylogenetic tree in order to better understand this gene family, which can aid in future cancer research.

Biology Independent Research
Faculty Mentor: Professor Ashley Byun

Alpha-Lactalbumin Purification and Characterization
Lucas Cabral '16
Abstract: Bovine α-Lactalbumin is the primary protein component of milk and is an essential nutrient. As part of the routine biochemistry 1 lab course, this protein is isolated from purified samples of whey from non-fat milk. The crucial step of isolation is performed via affinity chromatography where the unique copper component binds to the agarose column while the majority of other proteins elute through. While this is the most specific method of isolation, it's less cost effective than other methods. Instead, this experiment will be conducted in the same manor, but the proteins will be isolated using sephadex G-50 chromatography which separates proteins on the basis of size. While this method is known to be less specific, it is much more viable in terms of cost.

Biology Independent Research
Faculty Mentor: Professor Lenka Biardi

Fish Suck: Comparing Feeding Kinematics and Suction Pressure in Bluegills
Rachel Carlowicz '18, Caroline Rzucidlo '18
Abstract: Bluegills diverge into two ecomorphs based on habitat. Littoral bluegills primarily feed on invertebrate larvae found in the benthos and pelagic bluegills feed on Daphnia in the water column. This study compared feeding kinematics and suction pressure of the ecomorphs when feeding on brine shrimp, mealworms and earthworms. We hypothesized that pelagic bluegills would generate more suction to feed on brine shrimp while littoral bluegills would generate greater suction to feed on mealworms and earthworms. We found no significant difference in pressure between ecomorphs when feeding on mealworms and earthworms. However, littoral bluegills swam a greater distance to capture both prey types. When feeding on brine shrimp, pelagic bluegills began suction farther from the prey item and reached peak pressure faster. There were significant differences between the two ecomorphs, however they do not support the hypothesis that pelagic bluegills generate more suction when feeding on earthworms and mealworms.

Biology Independent Research
Faculty Mentor: Professor Shannon Gerry

Effects of Cholesterol Depletion on Leukemia Cell Viability
Michelle Cawley '16, Damini Patel '16
Abstract: Cancerous cells exhibit accelerated growth and proliferation compared to normal cells. Research has shown that limiting cholesterol availability can slow cancer cell growth. We explored the relationship between cell viability and cholesterol levels in K562 cells, a chronic myelogenous leukemia cell line. K562 cells were treated with methyl-β-cyclodextrin (MβCD), an agent that depletes cellular cholesterol from lipid raft regions of plasma membranes. Our results showed that methyl-β-cyclodextrin reduced K562 leukemia cell viability in a dose- and time-dependent manner in short-term assays (<6hr). Since K562 cells are early progenitors of erythrocytes, monocytes and granulocytes, we then examined whether MβCD-mediated changes in cholesterol levels impact erythrocyte differentiation. However, MβCD treatment at low concentrations (<2mM) and long term (24hr +) treatments did not appear to impact K562 cell viability or differentiation towards erythrocytes. Together, this study suggests that cholesterol metabolism may differentially affect leukemia cell viability and pathways of differentiation.

Special Topics in Biology
Faculty Mentor: Professor Catherine Andersen

Analyzing Morphometry and Orientation of Loggerhead Sea Turtle Hatchlings

Robert Schwartz '16, Layra Cintron Rivera '16, Jessica Romeo '16

Abstract: Loggerhead sea turtles (Caretta caretta) are a threatened species and are particularly vulnerable in the state of Rio de Janeiro, Brazil due to extensive coastal development. We examined orientation cues in loggerhead hatchlings and the potential association of morphometrics with their ability to successfully emerge from eggs and nests. We tracked hatchlings with GPS during their first minutes at sea to determine the relative influence of wave action, light, and magnetic fields on orientation behavior through the surf zone and open ocean. Contrary to past studies, it was observed that light may be the most important orientation cue in their first minutes at sea. We also compared morphometric measurements between hatchlings that were able to emerge and not emerge from their nests. We identified significant differences in carapace width and head length between these hatchling turtles suggesting that some aspects of morphometry potentially correlate with emergence ability.

Scholarship: Lawrence
Brazil Zoology Field Experience
Faculty Mentor: Professor Ashley Byun

Exploring the Relationship Between Lipoprotein Metabolism and Leukemia Cell Survival

Adam Doerr '16, Layra Cintron-Rivera '18, Lydia Dupree '18

Abstract: Cholesterol is a ubiquitous biological compound that is essential to cellular function. In addition to providing structural support and integrity to cell membranes, cholesterol and its metabolites also serve as regulatory signaling molecules that impact gene expression. Cellular cholesterol levels can be modulated through interactions with lipoproteins, including low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Research suggests that lipoproteins may impact cancer cell growth and survival due to their ability to mediate cholesterol flux into and/or out of the cell, thereby altering the availability of cellular cholesterol required for rapid cellular proliferation and membrane synthesis. Given the potential role of lipoprotein metabolism in cancer cell survival, this project investigates whether LDL and HDL can impact the viability and gene expression of human chronic myelogenous leukemia (CML) K562 cells. This study will further elucidate the clinical significance of cholesterol and lipoprotein metabolism in human health and disease.

Biology Independent Research
Faculty Mentor: Professor Catherine Andersen

Antimicrobial Activity of Bacterial Isolates from Crassostrea virginica and Black Rock Harbor's Water Column on Escherichia coli and Bacillus subtilis Growth

Cathryn Duemmler '16, Meghan Warchol '16

Abstract: Crassostrea virginica associated bacteria and water column organisms were used in a primary screen to test for the production of antibacterial compounds against tester strains of Escherichia coli (gram-negative) and Bacillus subtilis (gram-positive). Fourteen (A-N) isolates of bacteria were purified and determined to be either gram-positive or gram-negative. Individual isolates plated on marine agar were grown for seven days and subsequently UV treated. Tester strain cultures were suspended in soft agar and plated over the individual inactivated bacteria isolates. Growth inhibition was checked and results indicate that isolates G, H, and M did not inhibit growth of E.coli and B. subtilis. Isolates B and C appeared to reduce E. coli and B. subtilis growth. Isolate N reduced E. coli growth and inhibited B. sub growth. The diminished growth of tester strains by some oyster and water column bacteria suggests that these bacteria may contribute to antimicrobial protection against pathogenic bacteria.

Scholarship: Lawrence
Biology Research
Faculty Mentors: Professors Diane Brousseau and Phyllis Braun

"Keep Calm and Don't Drink the Water": Shedding Light on Fairfield University's Watersheds

Ryan Fritz '17, K'ron Simmons '18

Abstract: Since January of 2015, the environmental science lab research assistants have been part of an ongoing effort to monitor campus environmental quality. Field data used to evaluate and make recommendations to improve the campus watershed was collected and processed from nine on campus bodies of water throughout the duration of the school year and summer. The YSI model 85 probe was used to take the initial chemical readings of the water bodies. Water samples were collected for further chemical analysis in the lab. The data was entered into a database and statistically analyzed to determine if there is a correlation between seasonal changes, natural and unnatural events with non-point source fertilizer run-off. The data shows what Fairfield University is draining into the Long Island Sound and what changes the University needs to implement to reduce environmentally detrimental runoff.

Biology Independent Research
Faculty Mentor: Professor James Biardi

Whistling Wonder: Are Mating Calls Influenced by Body Size in Leptodactylus fuscus?
Sean Thomas '17, Ryan Fritz '17
Abstract: Whistling Frogs (Leptodactylus fuscus) are named for their distinctive, high-pitched mating calls. For the human ear, these calls appear to be uniform in pitch and length, regardless of the calling individual. However, a spectrogram analysis of the sounds reveals a range of variation in both frequencies and duration of the calls. It is unknown whether this variation has any significance — it could be related to the frogs' bodily dimensions and fitness. The spectrogram also reveals a "whimper" call that is more infrequent than standard calls and has a smaller frequency range. Latent characteristics of these calls could make certain males more appealing to females. Actively calling males from a population of Whistling Frogs from the União Biological Reserve in Brazil were recorded before being captured, weighed and measured for body length. Data were analyzed to assess whether call quality is associated with larger body dimensions and indicative of fitness.

Scholarship: Lawrence
Brazil Zoology Field Experience
Faculty Mentor: Professor Ashley Byun

Drone Research at the Beardsley Zoo
Jennifer Schwartz '18, Alex Fulco '16
Abstract: Animal enrichment, or the process of creating an engaging environment, is used to encourage natural behavior and increase breeding among animals in captivity. This lab investigated the affect of drones on certain animals at the Beardsley Zoo, observed the reactions of the animals to the drones, and investigated drones as animal enrichment tools. Additionally, drones were used to gain footage of animal enclosures from the respective animal's point of view. Animals investigated include wolves, bison, turtles, sea otters and large cats. The drones used were the Ollie Robot, the Parrot A.R. Drone, and a GoPro camera. Throughout the lab, animal interaction with the drones was observed and recorded. Additionally, the Parrot A.R. Drone's built in camera captured the surrounding enclosures from the respective animal's point of view, by being flown at the animal's eye level. The findings in this lab will encourage further research with drones and animal enrichment opportunities.

Vertebrate Zoology Lab
Faculty Mentor: Professor Ashley Byun

Feeding Strategies at the Beardsley Zoo
Meghan Grzybowski '16, Mary Smyth '18
Abstract: Mixed species exhibits in zoos are an exceptional way to provided a dynamic and interactive environment for animals. However, mixed species exhibits result in challenges as the different animals can interfere with the well being of others through harassment and food stealing. We explored different feeding strategies of callimico monkeys (Callimico Goeldii), a Red-Rumped Agouti, (Dasyprocta leporina) and a three-toed sloth (Bradypus), all residents of a single mixed exhibit at the Connecticut Beardsley Zoo. Issues of food stealing by the callimico monkeys from both the agouti and sloth required that some changes be made to feeding practices in this exhibit. After observing the behaviors of all three animals, we were able to devise simple new feeding methods, which successfully eliminated food stealing by the callimico monkeys.

Vertebrate Zoology Lab
Faculty Mentor: Professor Ashley Byun

Coteries in Crisis- Do Black-tailed Prairie Dogs Compete for Resources in Captivity?
Megan Kirkpatrick '17, Sean Thomas '17
Abstract: Black-tailed Prairie Dogs (Cynomys ludovicianus) are known for establishing tight familial bonds known as coteries. In the wild, coterie formation hardly depends on space, but rather on hierarchical behavior, resource availability, and population density. However, the colony of black-tailed prairie dogs at Connecticut's Beardsley Zoo faces different obstacles: space is likely the most critical limitation on their social development. Being surrounded on all sides by impenetrable concrete barriers places social pressure on the population. We have monitored this colony for two years through routine surveillance and an automated smoke machine to detect burrow connections in order to better understand the population dynamics and behavior of the colony. Signs of aggression, such as individuals with scarring and injuries, are still present despite adjustments in food placement. Various experiments involving the smoke-machine mapping, video camera traps, and dyed nesting material all seek to verify the presence of rival coteries.

Scholarship: Lawrence
Vertebrate Zoology Lab
Faculty Mentor: Professor Ashley Byun

Phenotype Analysis of a-Actinin-2 Heterozygous and Knock Out Mice
Firdaus Kudia '17
Abstract: During a summer internship at Boston Children's Hospital, the rare genetic disorder, congenital myopathies, was studied. During the internship, we wanted to study the function of alpha-actinin-2 in cardiac and skeletal muscles, therefore, we developed a mice model with a knockout of alpha-actinin-2. Since alpha-actinin-2 is responsible for slow twitched muscles, we further examined the phenotype of the knockout mice and exacerbate their phenotype under stress conditions.

Summer Internship
Faculty Mentor: Professor Shelley Phelan

Patterns of Foraging Behavior in Atta Leafcutter Ants
Nicolette Tiernan '16, Maria Levano '16
Abstract: Ant foraging is a collective process that involves the coordinated activity of many individuals. Leafcutter ants forage for enormous amounts of foliage, which they carry back to their nest in order to cultivate their underground fungus gardens. However, leafcutter ants are selective in what type of leaf or plant they will harvest.

We studied the effects of leaf size, leaf shape, distance, and chemical treatment on Atta foraging behavior to determine if they exhibited a resource preference at two different nests. Nest one was based on a relatively flat terrain while nest two was situated on a dirt hill alongside a trail in the União Biological Reserve in Brazil.

Based on analysis of our data, we conclude that selectivity is based on relative familiarity. Data suggests that this could be due to the fact that the treated food sources inhibit pheromone activity in the ant population.

Scholarship: Lawrence
Brazil Zoology Field Experience
Faculty Mentor: Professor Ashley Byun

Snowy Owl Observation at Connecticut's Beardsley Zoo
Laura London '16, Kenzie McCormick '16
Abstract: The species we studied, that the Species Survival Plan program has also been watching, is the snowy owl (Bubo scandiacus). Although of little concern in Europe, snowy owls are of great concern in the U.S. due to their low rate of reproduction. This lab aimed to determine if snowy owls at the Beardsley Zoo are likely to reproduce by manipulating the owl enclosure by moving familiar perching grounds (a tree and a wooden box) closer together to encourage the owls to be physically closer. In addition, owl mating calls were played aloud outside of the enclosure and camera traps were set up inside the enclosure to monitor the owls on a weekly basis. The info obtained from this study will ultimately help guide the zookeepers' decisions as to whether or not a new owl should be obtained and switched out with one of the zoo's owls to encourage mating.

Scholarship: Lawrence
Vertebrate Zoology
Faculty Mentor: Professor Ashley Byun

Effect of Temperature and Oxygen Variability on Two Fish Species in a Connecticut Lake
Coleman Macuch '17
Abstract: All organisms have specific habitat requirements necessary for survival. We studied variability in habitat conditions for fish in Lake Lillinonah in Western Connecticut. We chose northern pike and largemouth bass because they have different habitat preferences and are important for recreational fishing. We used literature values for physiological requirements and temperature and oxygen data collected by automated sensors, to determine the presence of optimal versus stressful conditions for each species. The results show that Lake Lillinonah experiences hypoxic conditions during the summer months, and stressful water temperatures for pike, but there is considerable variability among years. Current summer water temperatures are within the optimal range for bass, which is a warmer water species. As the climate continues to warm, we expect more frequent stressful conditions for both species.

Biology Independent Research
Faculty Mentor: Professor Jennifer Klug

Behavioral and Developmental Observations of Myrmecophaga Tridactyla at the Connecticut Beardsley Zoo
Samantha Porter '16, Alexandra Martin '17
Abstract: The Giant Anteater (Myrmecophaga tridactyla) is an insectivore endemic to Central and South America. Little is known about this species regarding basic behavioral patterns. The purpose of our research was to observe the behavior of two sexually mature Giant Anteaters at the Connecticut Beardsley Zoo. Direct observations were supplemented with multiple motion-activated cameras located within their indoor enclosure. These videos, along with staff reports, were collected and compiled twice a week. On Feb 13, 2016, the female gave birth to one pup. As a result, we began to focus our research on the development of the pup, behavior patterns between the pup and mother, and behavior patterns of the father. Videos taken mere hours before the estimated time of birth revealed dominance and mating behaviors in the male as well as stress, underscoring the importance of separating the male and the female before, during, and after the time of birth.

Vertebrate Zoology
Faculty Mentor: Professor Ashley Byun

Investigating the Function of Stabilimenta in Orb Webs
Kerri McPhail '16, Alexandra Martin '17
Abstract: For over two decades, scientists have puzzled over the presence of unique structures in the webs of some orb-weaving spiders called stabilimenta. Several hypotheses for the function of stabilimenta have been tested, including a prey-attraction hypothesis. The prey-attraction hypothesis states that these stabilimenta are employed by orb weavers as decorations to lure prey into their webs. To investigate whether stabilimenta served as a visual cue to attract prey, we created a series of webs drawn on fly paper. Over a period of nine days in January, 2016, we placed these artificial stabilimenta around several sites in the Atlantic Rainforest in Brazil. After 24 hours, these were collected and the number of insects caught was counted. Here, we report whether our data support the hypothesis that the stabilimenta function as a prey attractant.

Scholarship: Lawrence
Brazil Zoology Field Experience
Faculty Mentor: Professor Ashley Byun

It's Not How Much You Spend, It's Where You Spend It: How Consumer Behavior Predicts Dietary Energy Density
Amanda Massedge '16
Abstract: The objective of this study was to evaluate the relationship between consumer behavior and dietary energy density (ED) in a nationally representative sample of U.S. adults. A diet high in energy density is an established risk factor for obesity. Consumer behavior was evaluated by examining total dollars spent on food each in one of three categories: grocery stores, fast food/takeout and restaurant dining. The data indicates that low-ED diets do not cost more than high-ED diets. These results have implications for public health messaging regarding the cost of healthy eating. Our findings indicate that diets low in energy density can be obtained regardless of money spent at grocery stores, and that increased spending on take-away or fast foods predicts higher dietary ED. Strategies to educate consumers regarding low-cost "healthy" food options may be a successful method of slowing the obesity epidemic.

Scholarship: Lawrence
Biology Independent Research
Faculty Mentor: Professor Jacqueline Vernarelli

Antifreeze Peptide Disrupts Biofilm Formation in Streptococcus Mutans
Jenna Massaro '16
Abstract: Biofilms are communities of cells, surrounded by an exopolymeric matrix, that form on surfaces in the body or environment. Biofilms formed by bacteria such as Streptococcus mutans play a key role in the formation of dental cavities. Disrupting biofilm formation by S. mutans could help prevent dental plaque buildup on teeth. Here we show that a synthetic peptide, Antifreeze P1, can inhibit biofilm formation by S. mutans and other oral streptococci. It is also effective against biofilms of other Gram-positive bacteria. Using an in vitro tooth model of saliva-coated hydroxyapatite discs, we observed a dramatic reduction in attached biofilm biomass of S. mutans when incubated with Antifreeze P1. We used fluorescent microscopy and scanning electron microscopy to further visualize structural changes in Antifreeze P1-treated biofilms. This peptide has potential to be used as an anti-infective agent against dental pathogens or other biofilm-forming bacteria.

Scholarship: Mindlin and Lawrence
Biology Independent Research
Faculty Mentor: Professor Juliana Ansari

BIOLOG Microbial ID System: An Alternative Approach to Identify Unknown Microbes
Jenna Massaro '16
Abstract: The BIOLOG system is a relatively new alternative approach to microbial identification. In comparison to other current methods of identification, the BIOLOG system is both rapid and extensive as it makes use of a thorough phenotypic test panel. Here we followed the BIOLOG protocol to identify bacteria and yeast from food products, the environment, and the human body. We obtained three bacterial identifications from diverse sources: fermented sausage, human tooth, and the surface of a leaf. This approach has great potential in identifying less commonly known microbes, including yeasts, once the culture conditions are optimized. The BIOLOG system has promising applications not only as a tool for discovery-based labs in undergraduate biology education, but also in identifying and characterizing microbes from a wide array of sources.

Scholarship: Mindlin Foundation and Lawrence Foundation
Biology Independent Research
Faculty Mentor: Professor Juliana Ansari

'N Synch: The Evolution of Jaw Muscle Activation in the Batoids
David Neubauer '16
Abstract: Batoids (skates and rays) have specialized jaws that can function independently due to their cartilaginous skeleton, euhyostylic jaw suspension, and the presence of a highly flexible symphysis at the center of the upper and lower jaws. Sharks and skates have demonstrated unilateral activation when feeding on complex prey items. We investigated pairwise activation of the jaw muscles in four species of batoids (Dasyatis sabina, Gymnura micrura, Potamotrygon motoro, Urobatis halleri) from four families in order to examine the evolution of synchronous and asynchronous feeding behaviors. We hypothesized that these rays would use synchronous activation when feeding on small prey and unilateral activation to process larger prey items. Two asynchrony indices were used to quantify the duration of muscle activation and the lag, or degree by which muscles are activated out of phase.

Scholarship: Lawrence
Biology Independent Research
Faculty Mentor: Professor Shannon Gerry

The Relationship Between Light and Sound Stimulation in Cryptobranchus alleganiensis
Hayley Roberts '17, Marissa O'Donnell '18
Abstract: The hellbender (Cryptobranchus alleganiensis), a species of giant salamander found in eastern North America, and is currently on the IUCN Red List classified as near threatened. Little is known about hellbenders. This study assessed hellbender activity through tests that analyzed light and sound. This study tracked hellbender activity by observing walking, head movement, change in body orientation, swimming, and hiding under structures in the tank while light and sound were manipulated. Sound between 1,250 and 2,500 hertz were played in periods, which proved to periodically increase hellbender activity. Light was changed in varying degrees of intensity. This alteration of light proved that lower light intensity increased behavior where higher light intensity decreased behavior. The relationship possibly correlates with their nocturnal lifestyle. The connection between presence of sound and periodical increase in activity supports hellbenders sensitivity to vibrations. Information found in this study will hope to provide data for future experiments.

Vertebrate Zoology Lab
Faculty Mentor: Professor Ashley Byun

Lactic Acid Bacteria as a Preventive Agent Against Pathogenic Bacteria
Samantha Porter '16
Abstract: Lactic acid bacteria is naturally occurring in a wide variety of foods including dairy products and fermented foods. These cultures are considered beneficial to the health of the digestive tract due to the production and secretion of bacteriocins. Bacteriocins are protein-based toxins that kill closely related bacteria, some of which may be pathogenic. The purpose of the experiment was to screen for the presence of lactic acid bacteria in raw cheese and chaas (fermented yogurt) and to assess the bacteriocin activity against Vibrio fischeri, Vibrio harveyi, and Escherichia coli. This was achieved by homogenization of food products, isolation of lactic acid bacteria, and overlays inoculated with the bacteria of interest (V.fischeri, V. harveyi, E.coli). Preliminary results revealed that both food products contain bacteria of the Lactobacillus genus. Bacteria isolated from the chaas exhibited inhibition on Escherichia coli. No inhibition was present from lactic acid bacteria on Vibrio strains.

Water Research Seminar
Faculty Mentor: Professors Jo Yarrington, Olivia Harriott

Influenza A Virus: Interspecies Transmission
Elizabeth Szabo '16
Abstract: The factors that contribute to Influenza A interspecies transmission have not been fully understood. With several cases of interspecies transmission of avian and swine viruses, understanding factors than can lead to interspecies transmission are important, as well as knowing how protected a population is to currently circulating viruses that have the potential to transmit. This study evaluated the role of nonstructural protein 1 (NS1) from different viruses on the expression of the interferon response being a potential factor in interspecies transmission and the protection of a sample of individuals from Lebanon to currently circulating swine viruses. The results of the study suggested that inhibition of the interferon response may not be a leading factor in interspecies transmission. It was also found that the population tested showed low protection against currently circulating swine viruses, which can lead to possible pandemic if the viruses were able to transmit to humans.

Biology Independent Research
Faculty Mentor: Professor Brian Walker

C. Elegans Dynactin Mutants have Sperm Defects that are Rescued by Mutations to mel-28
Angela Tacinelli '17
Abstract: We have been using the nematode worm Caenorhabditis elegans to study genetic interactions between dnc-1 and mel-28 in animals. The dnc-1 gene encodes a component of dynactin, and dnc-1 mutant animals display an abnormally small brood size caused by low fertilization rates. The mel-28 gene encodes a nuclear pore component that is required for early embryogenesis. Reciprocal crosses between dnc-1 mutant and wild-type animals suggest that the fertilization defect in dnc-1 mutants is caused by faulty sperm. Disrupting the mel-28 gene rescues the sperm defect in dnc-1 mutant males, suggesting that in normal animals mel-28 function opposes dnc-1 function. Dissections of sperm from dnc-1 mutant males revealed that sperm activate prematurely and this could contribute to the fertilization defect. This study is the first to show that dynactin and mel-28 contribute to sperm function and could reveal a novel mechanism whereby activation of sperm is regulated.

Biology Independent Research
Faculty Mentor: Professor Anita Fernandez

Comparison of Efficiency of GMO Detection by PCR Using Lab Made Reagents vs. Commercial Kit
Kristen Rothdeutsch '17
Abstract: The efficiency of an Edwards buffer and PCR primers for GMO detection in food products was compared. Reagents made in the Molecular Biology Preparatory lab were compared to those supplied in a commercial kit.
DNA was extracted from three sources: non-GMO control plant tissue, a known GMO control plant tissue, and a snack food source that contained GMO corn product using either a lab-made Edwards buffer or kit-supplied Edwards buffer. A PCR comparison of kit-supplied primers versus lab-made primers of the DNA extractions was performed. Primers that detect the 35S gene (indicator of GMO) and tubulin primers (control for DNA extraction) were used in a PCR reaction and samples were then analyzed by agarose gel electrophoresis. Based on preliminary results, there does not appear to be any difference between the Edwards buffer and primers made in the lab and the reagents provided in the commercial kit.

Biology Independent Research
Faculty Mentor: Professor Lenka Biardi

The Disturbance on Atlantic Rainforest Bioacoustics
Frank Segreto '16, Monica Sciacca '16
Abstract: The Atlantic Rainforest of Brazil is considered one of the world's biological diversity hotspots. Although more than 90% of the original forest has been cleared, the remaining forest fragments are home to thousands of species that cannot be found anywhere else on earth. Our goal was to assess the degree in which forest fragmentation has influenced species diversity. Bioacoustic recordings were taken at two separate locations, one located one mile into the União Biological Reserve, and one at the edge of the reserve. Two ten-minute recordings were taken every three and a half hours from 6:30 a.m. until 7:30 p.m. All recordings were analyzed using RavenLight Pro and Avisoft and the results compared throughout the day and from site to site. Results show similar trends in species activity throughout the day, however, spectrogram analysis reveals a higher degree of bioacoustic complexity of the undisturbed habitat. This indicates that bioacoustics may be an effective way to assess species diversity in the future.

Scholarship: Lawrence
Brazil Zoology Field Experience
Faculty Mentor: Professor Ashley Byun

Find Me in the Jungle
Riley Smith '17
Abstract: Howler monkeys (Alouatta caraya), golden lion tamarin (Leontopithecus rosalia), and capuchin (Cebus capucinus) are all species of New World monkey found in Brazil's Atlantic rainforest. Due to urban and agricultural development, less than 8% of the original rainforest remains, fragmented in a small number of protected reserves. Over a two-week period during January 2016, a survey was conducted in the União Biological reserve in order to confirm the continued presence and relative location of howlers, golden lion tamarins, and capuchins. Surveys began at 5 a.m. every morning over four different reserve trails. The presence of monkeys was confirmed through vocalizations or by direct observations. Data recorded was then plotted on a satellite image of the reserve. Following data patterns, three species appear to be centralized at the middle area of the reserve, rather than the edges suggesting fragmentation is greatly reducing the land suited for habitation resulting in considerable range overlap.

Scholarship: Lawrence
Brazil Zoology Field Experiences
Faculty Mentor: Professor Ashley Byun

Characterization of a Genetic Network Affecting Fertility in the Nematode Worm C. Elegans
Gabriela Vida '16
Abstract: We are interested in understanding genetic interactions that affect fertility in the nematode Caenorhabditis elegans. Specifically we have been studying dhc-1, which encodes a component of the molecular motor dynein, dnc-1, which encodes a dynactin subunit thought to regulate 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. dnc-1 mutants have a sperm defect that is rescued by mutations to mel-28, suggesting that dnc-1 and mel-28 have opposing functions in sperm. Next we generated the mel-28;dhc-1;dnc-1 triple mutant and studied its brood size and sperm function. Our results suggest that the mel-28;dnc-1 interaction in sperm is independent of dhc-1 function but that defects to dnc-1 mitigate the severe reduction in brood size caused by simultaneous loss of dhc- 1 and mel-28.

Biology Independent Research
Faculty Mentor: Professor Anita Fernandez

Investigating Independent Origins of Aurora Kinase B in Nematodes and Insects
Wathone '17
Abstract: Aurora kinases A and B are proteins that play a vital role in cell division and much research has been dedicated to understanding their function and expression patterns. However, a majority of this research has been based on higher metazoans such as vertebrates. We have continued our previous research on the origin of aurora kinase genes in invertebrates in order to gain some insight into their origins and functional diversification. Our previous research indicated that all invertebrate animals have one copy of Aurora Kinase A, while only nematodes and insects seem to have both Aurora Kinase A and B. This led us to postulate that Aurora Kinase B originated independently along each of these two lineages. We have continued our research by determining the relative selection pressure on these genes over a range of vertebrate lineages in order to better understand the mechanisms by which they originated and continue to evolve.

Biology Independent Research
Faculty Mentor: Professor Ashley Byun

Beer, Bourbon, and Beakers: Phenolic Flavor Compounds found in Alcoholic Beverages
Kevin N. Vasquez '16, Nicholas Bernier '16, Robert Gargano '17, Hadley Orr '16
Abstract: We will present a comparative inquiry regarding brown ale and bourbon. We will compare the presence and relative quantities of phenolic flavoring compounds contained in brown ale and bourbon. The group decided that it was a topic of interest because phenolic compounds contribute to different tasting notes that people enjoy. The instrumental chemical analysis techniques used to analyze brown ale and bourbon were Gas Chromatography- Coupled Mass Spectrometry (GC-MS) and High Pressure-Liquid Chromatography (HP-LC).

Instrumental Analytical Chemistry Lab
Faculty Mentor: Professor Matthew Kubasik

Synthesis and Characterization of Symmetric and Asymmetric Water Soluble Zinc(II) Model Complexes for Liver Alcohol Dehydrogenase
Nicholas Bernier '16
Abstract: Liver alcohol dehydrogenase (LADH) is a zinc metalloenzyme that catalyzes the oxidation of alcohols to aldehydes and ketones and the reduction of a ketone or an aldehyde to an alcohol. Crystallographic data shows the resting enzyme has a zinc(II) metal center which is pseudo-tetrahedrally ligated with one N-histidine side chain, two S-cysteine side chains, and one water molecule. Our work involves the syntheses as well as NMR spectroscopic characterizations of novel water-soluble tridentate pincer ligand precursors. Our work also involves the syntheses, NMR spectroscopy, and electrospray mass spectrometry characterizations of both symmetric and asymmetric potential functional models of the zinc active site in LADH. We model the zinc active site using a family of tridentate pincer ligands coordinating S,N,S donor atoms. A detailed description of the syntheses and characterization of the ligand precursors and model complexes will be presented.

Scholarship: Lawrence
Chemistry Research and Seminar
Faculty Mentor: Professor John Miecznikowski

Synthesis and Characterization of Cobalt(II) Model Complexes for Liver Alcohol Dehydrogenase
Sheila Bonitatibus '17
Abstract: The Miecznikowski Laboratory investigates the preparation and reactivity of functional models of natural metalloenzymes, specifically liver alcohol dehydrogenase. The Miecznikowski laboratory has already synthesized and characterized a family of pincer ligand precursors with nitrogen and sulfur donor atoms, and has metallated the ligand precursors to form zinc(II) complexes, which are models for liver alcohol dehydrogenase. We are now interested in preparing cobalt(II) model complexes of liver alcohol dehydrogenase. The products will then be analyzed through multiple techniques including X-ray crystallography, NMR spectroscopy, ultra-violet visible spectroscopy, infrared spectroscopy, electron paramagnetic resonance spectroscopy, electrospray mass spectrometry, electrochemistry, and we will use density functional theory calculations to further understand our characterization results. The goal of the study is to answer the question of how well thiones model thiolates in biomimetic chemistry. The synthesis and characterization of the ligand precursors and cobalt(II) complexes will be presented.

Chemistry Independent Research
Faculty Mentor: Professor John Miecznikowski

Synthesis and Characterization of Self-Assembling Nucleopeptides
Samantha Schrecke '17, Kimberly DelBianco '17
Abstract: In the complex environment of cells, biomolecular structures have evolved a delicate balance between stability and dynamic responsiveness. Both of these factors rely on the strength and diversity of non-covalent interactions. In an effort design more responsive biomaterials, we have integrated the recognition elements of nucleic acids with self-assembling peptides. Herein, we report the synthesis of guanosine modified short peptides (nucleopeptides) and the characterization of the resulting supramolecular structures assembled in various conditions. Infrared spectroscopy (IR) was used to identify the major secondary structures, G-quartets and extended β-sheet formations, while Atomic Force Microscopy (AFM) was used to image the supramolecular fibers that form. Information from these self-assembling nucleopeptide studies will extend current strategies for "bottom-up" control of final morphology.

Scholarship: Lawrence
Chemistry Research and Seminar
Faculty Mentor: Professor Jillian Smith-Carpenter

FT-IR Spectroscopy, Computational Quantum Chemistry, and Hessian Reconstruction Analyses of Helical Peptide Isotopologues of Aib

Matthew Rotondaro '16, Jesse Dickovick '16, Chase Foster-Spence '16

Abstract: The Amide I vibrational band, in the carbonyl region of the mid-infrared, is known to be diagnostic of protein and peptide secondary structure. The sensitivity of the Amide I band to secondary structure requires a delocalization of Amide I normal modes among several C=O oscillators. We have investigated coupling in helical peptides through a combined experimental and computational approach. Our experiments employ isotope-edited FT-IR spectroscopy, where we have strategically enriched specific amide oscillators with C-13, shifting the Amide I band to frequencies below the broad Amide I envelope, revealing details of inter-amide coupling. We have performed DFT-based quantum mechanical calculations with fixed dihedral angles and C-13 isotopic substitution for identification of Amide I normal mode frequencies and inter-amide coupling constants. DFT results were analyzed with Cho's method of Hessian reconstruction to calculate local mode frequencies and inter-amide coupling constants.

Scholarship: Lawrence; Corrigan
Chemistry Research and Seminar
Faculty Mentor: Professor Matthew Kubasik

Solvent Mediation of Unimolecular Helical Exchange Dynamics in the Synthetic Helical Peptide Z-Aib6-β-Ala-OMe

Matthew Rotondaro '16, Jesse Dickovick '16, Chase Foster-Spence '16

Abstract: Our work characterizes the effects of solvent viscosity, polarity, and hydrogen-bonding capacity towards determining the rates of helical conformational exchange of a dissolved solute probe. Our work employs Z-Aib6-β-Ala-OMe, unique for its helical structure and its ability to undergo isoenergetic conformational exchange between left- and right-handed helices. We use 1H and 13C NMR spectroscopy to determine the rates of conformational exchange using line-shape analysis. We vary solvent viscosities by using a series of solvents and by varying sample temperature. Obtained rate constants are analyzed with Eyring treatments to characterize activation thermodynamics. We interpret the kinetic data with theories that admit an explicit role for solvent viscosity, such as Kramers' theory. Our unique peptide probe undergoes millisecond activated barrier crossings in its electronic ground state. This work provides novel insight into solvent influence in helical exchange dynamics in a unique synthetic polyamide system.

Scholarship: Lawrence; Corrigan
Instrumental Analytical Chemistry Lab
Faculty Mentor: Professor Matthew Kubasik

Comparing Levels of Theobromine and Caffeine in Milk, Dark and White Chocolate Using HPLC Analysis

John Domenico '16, Juliana Widak '16, Alexander LaCroce '16

Abstract: In a world where chocolate is digested every day, consumers need to be aware of the qualitative and quantitative assessments of alkaloids entering their bodies. Our group plans to analyze three types of Godiva® chocolate (dark, milk, and white), screening each sample for caffeine and theobromine. We aim to present the quantity of caffeine and theobromine in each sample using High Performance Liquid Chromatography. We will compare our HPLC data to literature data. Our milk and dark chocolate labels include percent cacao, with which we will compare our calculation of percent cacao using experimentally determined amounts of theobromine and caffeine. Additionally, caffeine and theobromine are only present in cacao, which is not present in white chocolate, therefore we do not expect to see any caffeine or theobromine in white chocolate.

Chemistry Instrumentation Lab
Faculty Mentor: Professor Matthew Kubasik

Complementing Electrochemical Studies of Self-Organized Gold Nanoparticle~Cytochrome c Superstructures with UV-Visible Spectroscopy

Nina Kosciuszek '17

Abstract: The addition of the protein, cytochrome c (cyt. c), to gold nanoparticles in solution results in self-organization of cyt. c into multilayered protein superstructures (abbreviated as Au~cyt. c superstructures) and stabilizes the thousands of organized cyt. c proteins to unfolding both when encapsulated in porous solids and when remaining in solution. Our research has shown that the electrochemical characteristics of superstructure-assembled cyt. c are enhanced compared to cyt. c alone. In order to determine whether the enhanced electrochemical properties are directly related to multiple protein layers staying intact at the electrode surface, protein superstructures were stripped from electrode surfaces and were measured with UV-visible spectroscopy. These results will aid in the development of future bioanalytical devices when a good understanding of the interaction between protein and material surface is needed.

Scholarship: Lawrence
Chemistry Research and Seminar
Faculty Mentor: Professor Amanda Harper-Leatherman

Synthesis and Characterization of Ruthenium (II) Carbene Complexes

Maura Morgan '16

Abstract: The Miecznikowski Laboratory is interested in preparing precatalysts for the reduction of aldehydes and ketones. We are particularly interested in preparing ruthenium(II) precatalysts as complexes containing this metal have been reported in the literature to catalyze the reductions of aldehydes and ketones. We have prepared a ruthenium(II) complex that contains the following ligands: p-cymene, two iodide ions, and 1,3 dimethyl benzimidazole. This complex was prepared by reacting ruthenium(II) para-cymene dichloride, 1,3 dimethyl benzimidazole iodide, potassium acetate, and potassium iodide. We have obtained a single crystal structure of the complex and are currently interested in preparing more of this complex and fully characterizing the complex using NMR spectroscopy. Another goal is to study the decomposition pathway of the complex as the p-cymene ligand may fall off during catalysis and thereby decomposing the catalyst. The syntheses and characterization of the ruthenium(II) complex will be presented.

Chemistry Research and Seminar
Faculty Mentor: Professor John Miecznikowski

Comparison of Alcohol Content and Volatile Compounds: Humulone and Cohumulone in Home Brewed Beer Versus Industry Brewed Beer, Stone IPA

George Naclerio '16, Chelsey Sidaras '16, Elizabeth Pacer '16

Abstract: In our comparison of industry brewed Stone IPA to home brewed beer, we effectively utilized redox titrations to analyze alcohol contents and HPLC (high-performance liquid chromatography) to study volatile compound content. The results of these titrations demonstrated that the Stone IPA (alcohol content: 6.9%) experimentally contained 5.66% alcohol, which we will then compare to the experimental alcohol content calculated for the home brewed beer (alcohol content: 5.5%). In regards to the flavoring components found within beer, we expect that the Stone IPA should have higher amounts of volatile compounds (both humulone and cohumulone) as compared to the home brewed beer because of the higher alcohol content. For this reason, the Stone IPA should also taste more bitter than the home brewed beer, a conclusion that will be made qualitatively. Our results are relevant to the industrial and social use of IPA beer.

Scholarship: Lawrence
Chemical Instrumentation Lab
Faculty Mentor: Professor Matthew Kubasik

Characterizing the pH Responsiveness of Dithiolane-Modified Peptide Self-Assembly Structures

Ruben Neves '17

Abstract: Recently, there has been great effort to develop a set of "bottom-up" design strategies that direct the assembly of peptides into specific supramolecular structures. The factors that control and stabilize peptide self-assembled structures, including side chain electrostatic interactions, sterics, and hydrophobicity, are non-covalent, and therefore reversible. One strategy to expand and diversify the intermolecular stabilizing interactions of peptide self-assembly involves the integration of dynamic covalent disulfide chemistry. Herein, we report the synthesis of lipioc acid-modified peptides and the characterization of the dynamic disulfide network on the supramolecular structures. The responsiveness of the supramolecular peptide surface disulfide-exchange polymerization to pH changes was investigated spectroscopically. The combination of dynamic covalent disulfide chemistry and peptide self-assembly will expand the current chemical diversity of biomaterials to yield environmentally responsive supramolecular assemblies with reactive surfaces.

Scholarship: Lawrence
Chemistry Research and Seminar
Faculty Mentor: Professor Jillian Smith-Carpenter

Synthesis and Characterization of SNS Pincer Ligand Precursors and Zn (II) Complexes

Tyler J. Ostrowski '16

Abstract: We have developed and synthesized a series of tridentate pincer ligands possessing two sulfur- and one nitrogen-donor functionalities (SNS), based on bis-imidazole or bis-triazole precursors. The tridentate SNS ligands incorporate thione-substituted imidazole or triazole functionalities. We have prepared somewhat rigid ligand systems through usage of 2,6-dibromopyridine as a ligand precursor. We have also prepared more flexible ligand systems by employing the starting material 2,6-(dibromomethyl) pyridine to introduce a methylene linker into the pincer ligand. We have metallated these ligand precursors to form zinc(II) complexes containing these tridentate ligands. We are interested in preparing ligand precursors based on 1,2,4 triazoles instead of 1,3,4 triazoles, which were previously prepared in the Miecznikowski Laboratory. The goal is to metallate the novel ligand precursors with zinc(II) and copper(II) salts. A detailed description of the syntheses, and characterization (NMR Spectroscopy and ESI-Mass Spectrometry) of the SNS zinc(II) complexes and ligand precursors will be presented.

Chemistry Research and Seminar
Faculty Mentor: Professor John Miecznikowski

Zinc and Copper Analysis of Ribbed Mussel (Geukensia demissa) Pallial Cavity Fluid
Elizabeth Pacer '16
Abstract: My research consists of analyzing the zinc and copper concentrations in the pallial cavity fluid of the ribbed mussel (Geukensia demissa). Zinc and copper, two metals with previously demonstrated potential defense properties, were detected in large concentration in Eastern oysters suggesting that these metals contributed to the Eastern oysters' antibacterial behavior. To determine whether a different, but related organism displays similar behavior with similar causes, I study the zinc and copper concentration of the pallial cavity fluid of mussels from the same area in Long Island Sound. I will make conclusions about the significance of zinc and copper in the mussel, and about the potential these metals have in organismal defense.

Scholarship: Lawrence
Chemistry Research and Seminar
Faculty Mentor: Professor Amanda Harper-Leatherman

Syntheses, Characterization, and Oxygen Reactivity of Three Coordinate SNS Copper(I) Pincer Complexes
Michael Smith '16
Abstract: Recently, we have developed and synthesized a series of tridentate pincer ligands, each possessing two sulfur- and one nitrogen-donor functionalities (SNS), based on bis-imidazole or bis-triazole precursors. The tridentate SNS ligands incorporate thione-substituted imidazole or triazole functionalities. We have prepared somewhat rigid ligand systems through the use of 2,6-dibromopyridine as a ligand precursor. In addition, we have prepared more flexible ligand systems by employing the starting material 2,6-(dibromomethyl) pyridine to introduce a methylene linker into the pincer ligand. We have metallated these ligand precursors to form copper(I) and (II) complexes. The complexes have already been synthesized and thoroughly characterized. The geometry of some copper(I) complexes allows for studies on the oxygen transfer activity. The copper complexes will be tested for reactivity toward hydrogen peroxide. A detailed description of the syntheses, characterization (X-ray diffraction, electrochemistry, UV-Vis), and reactivity of the SNS copper complexes toward an oxygen atom donor will be presented.

Chemistry Research and Seminar
Faculty Mentor: Professor John Miecznikowski

Engineering Projects

Prosthetic Hand Multi-Tool Attachment
Chris Babcock '16, Mike Nagy '16, Tom Daniello '16, Tom Lucakovic '16
Abstract: After losing their hand, most of the general public is provided a prosthetic that has a hook on the end, making simple everyday tasks more complicated than they need to be. Previously designed tools involved removing the hook and directly attaching a number of specifically designed tools for each individual task. Although every prosthetic arm is custom fit to the user, our tool provides a universal fit, allowing attachment onto all prosthetic arms, regardless of size, type, and customization, without removal of the main hook component. Through various design iterations and feedback analyses, the final design has four tools: a flashlight, a fork, a smart phone stylus, and a shopping bag carabiner. Tools lock into the optimal ergonomic position for use. The central housing design provides easy conversion from left-handed to right-handed use. Our final prototype is a combination of 3-D printed base, with manufactured metal tools and spring assembly.

Scholarship: Lawrence
Engineering Senior Design
Faculty Mentor: Professor James Cavallo

Understanding Stories Through Artificial Intelligence
Duy Creel '16, William McDonnell '17, Evangelos Boliakis '16
Abstract: An A.I. (artificial intelligence) is used for understanding information, which allows a machine to efficiently gather data and eventually act upon that data. We will create an A.I. program for understanding stories by incorporating text recognition and information acquired from a script applier mechanism, along with a conceptual analysis of natural language. The script applier mechanism program allows us to effectively apply created situational scripts in grammatical sentences for the user to comprehend, and the conceptual analysis of natural language details the construction of concepts through keywords and phrases. Our goal is to finish our basic program with the ability for a user to input a text, and the A.I. to output answers asked by the user via a graphical user interface. Although basic, this program will be the building block for future reading applications.

Engineering Senior Design
Faculty Mentor: Professor Jamie Macbeth

Tabletop Micro Patterning Device
Ryan Brown '16, Noel LaFlamme '16, Gabriel Schrier '16, Michael Valvano '16
Abstract: Micro patterning is being done through processes of photo or soft lithography. These processes are typically conducted in closely monitored locations such as clean rooms. Since a clean room is expensive to set up, places such as labs and universities have a hard time suiting their needs to micro pattern. The aim for our project was to build a small tabletop micro patterning device that will fulfill the same outcomes as the above methods, but in a less costly and resource intensive way. This device will be about a square foot in area and will be portable, allowing the user to have it on a table, classroom, or even the international space station if needed. The device will consist of a press plate containing the master mold, which will be used to imprint the micro pattern onto a silicone substrate.

Scholarship: Lawrence
Engineering Senior Design
Faculty Mentor: Professor Sriharsha Sundarram

Active and Passive Noise Cancellation Applied to an Ordinary Household Appliance
Tony Phantharangsy '16, Christopher Calitri '16, Michael LoTurco '16, Vincenzo Moretti '16
Abstract: Vacuums are a common household appliance, making noise that people are all too familiar with. The average Shop Vac produces 81 dBa of noise from 10 feet, which can be quite the nuisance. The majority of the noise comes from air turbulence within the vacuum as well as changes in flow velocity. To combat the noise, passive and active noise cancellation techniques will be implemented. A redesigned, smooth air flow path will cut down on turbulence and insulation will help cut down on vibration. An adaptive filter will take in the noise that the vacuum makes, create an anti-noise, and emit it through a speaker to cancel some noise. With these techniques, the vacuum is expected to be 17-20 dBa quieter.

Scholarship: Hardiman
Engineering Senior Design
Faculty Mentor: Professor Jeffrey Denenberg

Differential Thread Adjusters
Kevin D. McCaffrey '16, Brian Herman '16, Brett Mikolajczyk '16, Chris Rutigliano '16
Abstract: Sensitive opto-mechanical mounting applications, such as those used in photolithography applications, require extreme stability in order to provide the high resolution details demanded in the nanometer range. These mounts must be stable in position when exposed to stress induced by loading, temperature variation, and vibration. Preventing drift over time is of particular interest to prevent frequent and often costly recalibration of these mounts. In addition to these mounts being stable, they also must have the appropriate adjustment sensitivity to be able to precisely set the mounts in their particular application. The main objective of this project is to study the stability and adjustment sensitivity of commercially-available-off-the-shelf (COTS) Differential Thread Adjusters (DTA's) versus custom designed adjustment methods such as Fine Pitch Adjusters and DTA's, while evaluating their commercial feasibility.

Engineering Senior Design
Faculty Mentor: Professor Andrew Judge

Medispense
Austin Hliboki '16, Kevin Zwick '16, Haasim Vahora '16, Cameron Sayles '16
Abstract: For our senior design project, our group designed a universal medicine dispensary system for use by patients who are susceptible to improper medication. Both over-medication and under-medication are serious and life threatening issues that many patients who suffer from Alzheimer's or dementia are prone to. Our goal is to design a prototype system that will store, dispense, and keep track of medications with as little effort from the patient as possible in order to reduce these risks and improve their lives overall. The prototype will use a vacuum arm to suction the proper medication and fulfill the patient's subscription as well as use a variety of methods to alert them that their medication is ready. The device will be exact and secure to eliminate any possibility of the patient over-medicating and use the multi-layer alert system to ensure that the patient has taken the medication.

Scholarship: Hardiman
Engineering Senior Design
Faculty Mentor: Professor Ryan Munden

Automated Alignment of a Laser Welded Medical Device
Steven Shiner '16, Austin Wesolowski '16, Christian Vrankovic '16, Yaroslav Kohut '16
Abstract: Our team has been tasked by Northeast Laser and Electropolish to automate the process of straightening medical devices used in endoscopic knee surgery. These devices are created by laser welding a tube to a cap; however the weld periodically creates a fractional bend outside of the vendor requirement, which is 0.002 inches of total radial deviation. By applying a perpendicular force to the cap of the device as it's rotating, the cap will bend back into within the vendor's tolerance. Our final design includes a Dunham Lathe that holds a 5C collet within its spindle, an armature with two tangential roller ball bearings that is connected to a series of X and Y-directional linear actuators, an M-Drive step motor that will rotate the device, and a pressurized air system that will lock the device into place. Our design targets to align more than three medical devices per minute in production.

Engineering Senior Design
Faculty Mentor: Professor Michael Zabinski

Mobile Application for Match Optimization for Soccer Referees
Philip Mayer '16, Drew Mignosa '16, Kevin Willson '16
Abstract: Even at the highest professional levels of soccer, referees still record relevant game data manually and must later input it into electronic systems for league standings, statistics, and eligibility. These recordings are prone to human error, and there may be discrepancies between individual referee recordings resulting from an inability to communicate easily and effectively. We designed and implemented a cross-platform mobile application that automates the recording and collection of game data on penalties, goals, and more. In our system, referees – using either Android or iOS devices – connect to a central server acting as a point of entry and communication facilitator between each mobile device. Based on the client-server architecture, our implementation features secure authentication, intuitive and simple information entry, and efficient data sharing. The system has the potential to change the way soccer is both administered and spectated, and may also be extended to other competitive games.

Scholarship: Lawrence
Engineering Senior Design
Faculty Mentor: Professor Amalia Rusu

Health Studies Projects

Electronic Medical Records
Daley Baldwin '16, Matthew Engel '16
Abstract: Our study investigates the use of electronic medical records and electronic health records. We were interested in understanding how electronic health records impact the quality of care in a provider- patient relationship. We also wanted to investigate new technologies for patients in recording and tracking their own personal health and fitness.

Health Studies Capstone
Faculty Mentor: Professor Michael Pagano

Direct-to-Professional Pharmaceutical Advertising and its Effect on Health Care in the United States
Nicole Capra '16
Abstract: The pharmaceutical industry is one of the most profitable sectors and biggest spenders on marketing in the United States with approximately 10 cents of every U.S. health care dollar spent on pharmaceutical drugs (Fischer, 2014). Advertising directly to health care professionals (DTP) accounts for the bulk of pharmaceutical marketing expenditures and includes detailing, sample giveaways, medical journal advertisements, and informational events. This study analyzes five DTP advertisements for marketing strategies used to optimize pharmaceutical companies' ability to educate and promote new drugs to health care professionals. Through a review of current literature, this study also discusses the impact that DTP pharmaceutical advertising has on physician-prescribing behavior and the ethical debate of whether persuasive marketing activities create a conflict of interest on the part of the physician.

Health Studies Capstone
Faculty Mentors: Professors Michael Pagano, Brian Walker

Direct-to-Consumer Pharmaceutical Advertising and Its Impact on Health Care
Lauren Falkanger '16
Abstract: The market for direct-to-consumer pharmaceutical advertising has immensely grown in recent years. While there are some restrictions and regulations in place for what pharmaceutical companies can advertise, the market is driven by capitalist demand and the industry of DTCA is viewed merely as a business now. This project will use scholarly reviews to further look at the impact that direct-to-consumer advertising has on the attitudes of consumers, emotional and endorser appeals, perceptions of consumers, and lastly, the costly implications. In today's market, pharmaceutical companies are seen using a variety of methods and tactics to entice consumers to ask providers for prescription medications. This project will also analyze five DTC ads as a means to understand the methods and tactics that are used in various advertisements. The results will provide further analyses of ways in which pharmaceutical companies are successful in their advertising methods to consumers.

Health Studies Capstone
Faculty Mentors: Professors Michael Pagano, Brian Walker

Fairfield University Health Portal
Ryan Saunders '16, Alexander Fulco '16
Abstract: The goal of this project is to create a health and wellness-based website for the entire Fairfield University community. Working with the National Consortium for Building a Healthier Academic Communities, we aim to create a completely integrated website that students, faculty, and staff can use as a tool for their health and wellness. Currently on campus there is no integrated system that has all the health resources available in one place. This website would tie together all areas of health and wellness on campus including physical, mental, financial, spiritual, and nutritional.

Health Studies Capstone
Faculty Mentor: Professor Brian Walker

Disparities in Access to Nutritional Food in Food Pantries and their Impacts on Diet-Related Health Outcomes
Jaime Hinkel '16
Abstract: Chronic Illnesses such as cardiovascular disease and diabetes are heavily influenced by the nutritional quality of an individual's dietary intake. Individuals who are most susceptible to these illnesses are food insecure individuals who, because of insufficient economic resources, are unable to have reliable access to safe and healthy foods. Many of these individuals must rely on emergency food resources such as food pantries to provide for themselves and their families. The nutritional quality of the foods that are found in these pantries is of vital importance to the overall health and well being of food insecure populations. The purpose of the current study is to evaluate the nutritional quality of foods found in pantries in Bridgeport, CT to see if the quality of these foods is reflected in the health outcomes data (i.e. blood pressure, BMI, and blood glucose) of individuals who frequent these pantries.

Health Studies Capstone
Faculty Mentor: Professor Brian Walker

Dietary Energy Density is Associated with Gestational Diabetes Status in U.S. Women
Victoria Lofaro '16
Abstract: The objective of this study was to determine the relationship between Gestational Diabetes (GD), and dietary energy density (ED) in a nationally representative sample of pregnant women residing in the U.S. who participated in the 2009-2012 National Health and Nutrition Examination Surveys (NHANES). Diet quality was assessed using HEI component scores, with FNDDS food codes. Data regarding gestational diabetes (GD) status was provided by the NHANES. Women were categorized as having a positive diagnosis for GD, having a diagnosis of "borderline GD," or having no gestational diabetes. All data were analyzed using appropriate survey weights and procedures in SAS 9.3. Our results indicate dietary ED, calculated using food only, is positively associated with gestational diabetes. Women without gestational diabetes have a significantly lower dietary ED than those with gestational diabetes or those with borderline gestational diabetes.

Scholarship: Lawrence
Health Studies Capstone
Faculty Mentor: Professor Jacqueline Vernarelli

The Effect of Alternative Therapies on Decreasing Psychosocial Aspects in Women Undergoing IVF
Jenna Massaro '16
Abstract: In vitro fertilization (IVF) can negatively affect psychosocial factors of women undergoing the treatment. The use of alternative therapies to treat stress and anxiety has been applied in conjunction with IVF. This systematic review aims to evaluate the effect of alternative therapies on decreasing psychosocial factors in women undergoing IVF treatment. Papers included in this review were published in the last six years, and study participants were limited to women undergoing IVF as well as some form of alternative intervention. Additionally, the study had to be measuring the effect of the alternative therapy on decreasing psychosocial measures (i.e. anxiety, stress, etc.). Databases CINAHL and PubMed were searched, yielding 12 relevant studies, one of which was qualitative while the rest were quantitative. Overall, results demonstrated that alternative therapies, for the most part, decrease anxiety and stress for women undergoing IVF.

Health Studies Capstone
Faculty Mentor: Professor Jenna LoGiudice

Characterization of Cancerous Lung Tissue via Fluorescent Biomarkers
Daniel Quinn '16, Dominic Schioppo '16
Abstract: Cancer is a disease that affects millions of people each and every day. This terrible disease has been the focal point of numerous research studies that are designed to gain more useful information and a better understanding of the complexity of cancer. This study is intended to elucidate the properties of cancerous lung cells using the ratios of expression of innate fluorophores and excitation techniques via various wavelengths of light, which can lead to easier identification of cancerous lesions.

Health Studies Capstone
Faculty Mentors: Professors Brian Walker, Min Xu

Today in Global Health
Veronica Suglo '16
Abstract: Global Health is defined as a branch of public health that looks at the various health issues that transcend national boundaries by examining how individuals in low resource areas of the world experience healthcare. In 2005, The Honourable Aileen Carroll, Minister of International Cooperation of Canada, said that "The ultimate goal of global health is to reduce the number of people, importantly children, dying unnecessarily from ill-health and disease." This presentation will seek to highlight today's global health issues by examining three of the most devastating global health outbreaks within the last 15 years and analyze efforts made by organizations such as the World Health Organization and the United Nations to resolve these issues as well as propose a new or revised solutions.

Health Studies Capstone
Faculty Mentor: Professor Brian Walker

Mathematics Project

Limiting Distributions for Topological Markov Chains with Holes
Philip Mayer '16
Abstract: How do mathematicians study chaos? How can we begin to study systems intrinsically lacking order? In our poster, covering research completed for the 2015 Fairfield REU in Mathematics and Computational Science, we introduce the methods used by mathematicians to study the evolution of dynamical systems and their statistical properties. We discuss our findings, namely proofs for the existence of limiting distributions, which represent equilibria for different classes of systems, including those from which mass or energy may escape.

REU Mathematical Research
Faculty Mentor: Professor Mark Demers

Physics Project

Optical Detection of Cancer
Run Li '16, Kevin Vasquez '16
Abstract: Cancer diagnosis is critical in patient care yet it currently mainly depends on subjective evaluations by a pathologist. Objective alternative cancer diagnosis methods are urgently needed to enhance the accuracy of cancer diagnosis. Our project is one part of "Optical Pathology" research to develop novel approaches of cancer detection with light. The goal of this project is to discriminate cancerous activities from non-cancerous activities from quantitative microscopic study of lung cancer slides. We are focusing on determination of the molecular and structural properties of individual cell of lung tissue and seeking the difference in cancerous and normal tissue. We are using fluorescence microscopy for gathering molecular concentrations, and differential interference phase microscopy for acquiring structural properties. We will also investigate and characterize differences in adenosine triphosphate (ATP) concentration in normal and cancerous lung tissue to develop an objective lung cancer diagnosis method.

Scholarship: Lawrence
Psysics Independent Research
Faculty Mentor: Professor Min Xu

Psychology Projects

An Examination of the Relationship Between Entitlement, Gender and Sexual Consent Behaviors
Brigid Callahan '16
Abstract: The present study investigates if undergraduate students' gender and sense of relationship entitlement are associated with specific types of behaviors they perceive utilizing to convey sexual consent, as well as to the behaviors they expect their intimate partners to use to convey sexual consent. A quasi-experimental design is employed. The IV's are gender and participant score on a self-report measure of relational entitlement (restricted, assertive, or inflated). The DV's are participant's scores on self-report measures of the utilization (and expectation of others to utilize) different sexual consent behaviors (nonverbal signals of interest, passive behaviors, initiator behaviors, verbal cues, and removal behaviors). Data collection for this study is ongoing. Findings from this research could potentially expand existing knowledge of how college students conceptualize and engage in sexual consent, and create more informed interventions for sexual assault prevention and education regarding sexual consent.

Psychology Independent Research
Faculty Mentor: Professor Margaret McClure

The Effects of Acute Intranasal Oxytocin on Anxiety and Social Behaviors
Kristina Gallagher '16
Abstract: In humans, exposure to valproic acid (VPA) during development is associated with an increased risk for Autism Spectrum Disorder (ASD). One potential treatment is oxytocin (OXT), a neuropeptide involved in social behaviors. This study was conducted to examine whether acute OXT would restore social behaviors in VPA-exposed females. Pregnant rats were injected with 600mg/kg of VPA or saline. After weaning, pups were assigned to three test groups: VPA-exposed treated with OXT(n=5) or saline(n=5) and saline-exposed treated with saline(n=6). Administration of the treatment was done before behavioral testing for anxiety (elevated plus maze) and social behaviors (sociability test). We found differences between VPA-sal and other groups on elevated plus maze. On the sociability test, VPA-sal rats spent less time with the novel rat than controls ($p<.07$) suggesting they were less social, and OXT appeared to restore the behavior. A new test for prosocial behaviors is being piloted and will be explained.

Psychology Supervised Research
Faculty Mentor: Professor Shannon Harding

"We Need Excitement!" vs. "We Need Comfort": The Relation of Positive and Negative Empathy to Different Relationship Goals in Close Relationships
Deanna Martinelli '16, Jaqueline Orlandi '16, Jennifer Mezzapelle '16, Mary Gaughan '16
Abstract: The present study explores the relationship between positive and negative empathy and social motivations within romantic relationships. We expected that positive empathy, which entails strong identification with others' positive emotions, would relate to a motivation to approach growth and excitement in relationships. In contrast, we expected that negative empathy, which entails strong identification with others' negative emotions, would relate to a motivation to avoid conflict and anxiety in relationships.

To test these hypotheses, we measured participants' levels of positive and negative empathy, as well as a number of indicators of their relationship-related approach and avoidance motivations (e.g., what kinds of goals do they have for their relationships? Do they encourage their partners to "take chances" to grow or to "play it safe?").

Results showed a clear relationship between positive empathy and approach motivations, as well as a relationship—albeit a weaker one—between negative empathy and avoidance motivations.

Scholarship: Lawrence
Psychology Supervised Research
Faculty Mentor: Professor Michael Andreychik

Cognition Impairments in Personality Disorders: Working Memory in Schizotypal PD, Avoidant PD, and Healthy Controls
Maddi Gervasio '16
Abstract: Schizotypal personality disorder (SPD) individuals have impaired cognitive functioning similar to schizophrenia patients, but the extent of this similarity is not fully known. This study focuses on the working memory of SPD individuals, compared to Avoidant Personality Disorder (AvPD) individuals and Healthy Controls (HC). The hypothesis is that SPD participants will have greater impaired working memory, lower PASAT scores and higher DOT test scores than AvPD participants, and SPD and AvPD will have greater impairment than the HC; as well as impairments found in SPD participants will be consistent with impairments in schizophrenia. SPD participants had significantly greater impairments than AvPD participants, $t(96)= 2.44$, $p < .001$, and HC $t(109) = 3.97$, $p < .001$. AvPD participants had significantly greater impairments than HC, $t(101) = 1.29$, $p = .021$. Therefore, the impairments are due to the fact that SPD is on the schizophrenia spectrum.

Psychology Supervised Research
Faculty Mentor: Professor Margaret McClure

Examining High Levels of Positive and Negative Empathy as Risk Factors for Different Clinical Disorders
Teah Hayward '16
Abstract: Existing work has distinguished empathizing with others' positive and negative emotions as two separate processes, both with positive implications for relationships and prosocial behaviors. But, this work also suggests that there may be negative consequences of extremely high levels of negative or positive empathy. This study demonstrates the clinical implications of having high levels of either positive or negative empathy by finding that high levels of negative empathy are positively correlated with a greater risk for depression, while high levels of positive empathy are positively correlated with a greater tendency to take risks, which is related to multiple clinical disorders. Contrary to the hypothesis, high levels of positive empathy were not found to be correlated with a risk for mania. Together, these results provide evidence that positive and negative empathy may contribute to risk factors for clinical disorders, including depression, alcohol use disorder, and gambling addiction.

Psychology Independent Research
Faculty Mentor: Professor Michael Andreychik

Reducing Your Suffering or Increasing Your Joy?: Negative Empathy Predicts Helping Others to Avoid Negative Emotions Whereas Positive Empathy Predicts Helping Others to Approach Positive Emotions

Eliza Lewis '16

Abstract: I explored the relationship between positive and negative empathy and approach and avoidance motivations. Because individuals high in positive empathy are particularly sensitive to others' positive emotions, they should be especially motivated to help others to approach such positive emotions. In contrast, because individuals high in negative empathy are sensitive to others' negative emotions, they should be motivated to help others to avoid suffering.

In Study 1, I found that positive and negative empathy were related to dispositional levels of approach and avoidance motivations and to approach- and avoidance-related personality traits. In Study 2, I presented subjects with a helping appeal framed either in terms of helping to alleviate another's suffering or helping to increase another's joy. Here, negative empathy predicted helping only when help was framed as a way to avoid suffering, whereas positive empathy predicted helping only when help was framed as a way to approach joy.

Scholarship: Lawrence
Psychology Independent Research
Faculty Mentor: Professor Michael Andreychik

Scientific Method, Scientific Facts and Spiritual Orientation

Alisia LoSardo '16, Justin Paton '17

Abstract: Modern-day society runs on science, however the extent to which individuals truly understand its fundamental principles and practices is open to question. The results of previous studies indicate that individuals – both laymen and academic intellectuals – tend to know far less about science than they think. This is especially true of the science of psychology, in which the subject matter is, or at least includes the behavior of the scientists themselves. The current study sought to identify links between one's professed knowledge of The Scientific Method, their actual knowledge of scientific facts and concepts and their expressed degree of spirituality. Participants – composed of both students and faculty – completed a survey consisting of a biographical component and several-information gathering components aimed at determining the true extent of scientific understanding and commitment. The ultimate aim of our study is to determine why scientific findings are so often ignored or disregarded by modern society.

Psychology Independent Research
Faculty Mentor: Professor Ronald Salafia

Effects of Intranasal Oxytocin on Anxiety and Social Behaviors in an Animal Model for Autism

Ellen Masters '16

Abstract: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by social and communicative impairments. Exposure to valproic acid (VPA) during pregnancy produces ASD-like symptoms in offspring, making this a plausible rodent model for the disorder. Because oxytocin (OXT) is a neuropeptide that contributes to social behaviors, we studied whether intranasal administration would improve behavior in VPA-exposed male rats. Pregnant female rats were injected subcutaneously with VPA (600mg/kg) or Saline on gestational day 12.5. Male offspring then received 0.8 IU/kg of OXT or Saline from P21 to P41. Tests for anxiety, sociability, and sociosexual behaviors were conducted, and revealed that VPA rats show heightened anxiety ($p<.05$) and reduced sociability ($p<.05$) compared to controls. Additionally, OXT treatment appeared to restore behavior to normal levels. We predict OXT to enhance sociosexual behaviors. These findings have direct implications for the treatment of neurodevelopmental disorders like ASD with OXT.

Scholarship: Magis Scholar
Psychology Independent Research
Faculty Mentor: Professor Shannon Harding

The Impact of Co-Rumination on Negative Affect: An Exploration of Gender Differences

McKenna O'Shea '16

Abstract: Previous research has pointed out the significance of co-rumination and its impact on stress and depression levels, especially in women who are more likely to preform the behavior. One hundred and twenty nine participants were tested on how much co-rumination impacts stress and if the propensity to co-ruminate is greater in females than in males. Participants were given a demographics questionnaire, a Beck Depression Inventory II, and a Co-Rumination Questionnaire. They were then given a stressful or neutral prompt to write about, and then answered a Positive and Negative Affect Schedule. Next they were given another stressful or neutral prompt, and then answered the same questionnaire. Our results showed a significant relationship between co-rumination and negative affect, but not between gender.

Psychology Independent Research
Faculty Mentor: Professor Margaret McClure

Protestant Work Ethic and Locus of Control in Determining Predicted Post-Undergraduate Career Success: Private University vs. Community College

Ryan Saunders '16, Marco Rodis '16

Abstract: This study investigated levels of Protestant Work Ethic and Locus of Control and post-undergraduate career aspirations between private university and community college students. Undergraduates from a private university and a community college in Connecticut were given a survey consisting of career and education oriented questions, the Protestant Ethic scale, and the Internal-External Locus of Control scale. Results suggest that community college students have more of a drive to become successful in spite of factors that would seem to hold them back. Conversely, private university students appear to sincerely believe that they are unable to become upwardly mobile in the world due to their previous generation's success. These results highlight a serious disparity among college students that had not been present in previous generations. This could have significant implications on the way students may be educated and prepared for their careers.

Psychology Independent Research

Faculty Mentor: Professor Dorothea Braginsky

Adult Attachment Style as a Predictor of Intimate Partner Violence, Depressive, and Trauma Symptoms in College Dating Relationships

Margaret Trosin '16

Abstract: This study examines adult attachment styles and its relationship to Intimate Partner Violence (IPV), depression, and early trauma symptoms in college dating relationships. The data will analyze attachment styles as a predictor of IPV perpetration and victimization, depressive symptoms, and trauma symptoms in undergraduates at Fairfield University. This is a quasi-experimental design, and four ANOVAs will be conducted: with attachment style as the independent variable, and perpetration of IPV, victimization of IPV, depressive symptoms, and early trauma symptoms as the dependent variables. Follow-up testing will be conducted in significant differences present themselves.

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Faculty Mentor: Professor Margaret McClure


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