Spring 2015

2015 Annual Research Symposium Abstract Book

Trinity College, Hartford Connecticut

TWENTY-EIGHTH ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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BIOLOGY

1.
THE EFFECT OF ESTRADIOL β-17 ON THE GROWTH RATE OF *SYNECHOCOCCUS* SP. *IN VITRO*
Elizabeth Adrian '16, Maura Griffith '17
Faculty Sponsor: Craig W. Schneider

Although investigations have been conducted on the impact of pharmaceutical pollutants on a number of aquatic fauna, the impact of these compounds on phytoplankton have largely been ignored. As a result of a lack of EPA regulations, pharmaceuticals such as estradiol β-17, a form of estrogen, are often introduced into the natural environment through waste water. A thorough search of previous work showed that the range of estrogen in wastewater is 0.35 ng/L to 10.0 µg/L. For the present study, we selected two concentrations of estradiol β-17 that fell within this range, 0.05 ng/mL and 0.005 ng/mL, as well as one extreme level 0.05 µg/10 mL, to test on the growth rate of a locally isolated cyanobacterium, *Synechococcus* sp.. A unialgal culture was isolated from Tankerhoosen Stream in Bolton, Connecticut, and grown in Bold's Basal medium at 15℃. Three replicates of each culture, as well as a control, were incubated at 15℃ and a 16L:8D photoperiod for a duration of five days. Although there was no significant difference in the growth rate between the various concentrations, results showed that the growth rate of *Synechococcus* sp. significantly decreased in the presence of estrogen.

2.
EFFECTS OF pH ON THE GROWTH OF THE CYANOBACTERIUM, *ANABAENA*
Justin Beslity '15, Michael McQuiston '16
Faculty Sponsor: Craig W. Schneider

Pollution in today's world has led to a host of problems within ecosystems. Acidification of landscapes remains one of largest augmenters of the biosphere, therefore constant research is needed to enact effective policy to reverse possible damage. Our research focused on acid rain, a common bi-product of burning fossil fuels. Acid rain can have negative growth effects on marine and freshwater planktonic algae and cyanobacteria. However, the protective mucilage covering certain species of cyanobacteria, including *Anabaena* spp., may behave differently in varying pH regimes. This could be useful if cyanobacteria prove resistant to variable pH environments, as they could be theoretically used to replace locally extinct species in certain habitats with abnormal pH levels caused by man-made toxins. Using a freshwater species of *Anabaena*, we investigated how varying pH levels affected growth. Adjusting the pH of the Bold's Basal medium using minute concentrations of potassium hydroxide, solutions were created at pH values 5.0, 5.5, 6.0, 6.5, and 7.0. Cultures were then incubated at 15˚C on a 16L:8D diurnal cycle. Growth rates were determined by measuring chlorophyll b densities via Turner Desgin's *Aqua*Fluor handheld fluorometer, and these were used to estimate culture growth. Cultures with more acidic pH values resulted in lower average chlorophyll b concentrations, when compared to the cultures more neutral in pH.

3.
CHANGING THE ORDER OF THE EGF-LIKE REPEATS IN THE SERRATE LIGAND TO INVESTIGATE POSITIVE AND NEGATIVE NOTCH SIGNALING
Scott J. Buchanan '17
Faulty Sponsor: Robert Fleming

Serrate is a ligand molecule with 14 extracellular EGF-like repeats (ELRs) that can either activate or inactivate its cellular receptor, Notch. Removal of ELRs 4-6 from Serrate ablates its ability to inhibit Notch without affecting its ability to activate Notch. It has been previously discovered that relocating ELRs 4-6 of Serrate to a position after ELR 11 of the molecule does not restore the ability to inhibit Notch. This suggests that the distance between repeats 4-6 and the activator region (N-terminus through ELR3) may be critical for inhibition. The question addressed here is how far can ELRs 4-6 repeat be moved from its original location before it again becomes unable to inhibit Notch. We have developed a construct that contains ELR 7 in between repeats 3 and 4. This separates the inhibitory repeats from the activator by a single ELR. The overall objective is to determine what effect this separation will have on the ligands ability to inhibit Notch by mis-expressing the modified construct in the developing Drosophila wing.

4.
THE EFFECTS OF HUMAN SCENT ON THE FORAGING BEHAVIORS OF THE EASTERN GRAY SQUIRREL
Jared S.M. Cotton '15, Lisley C. DaSilva '16
Faculty Sponsor: Michael O'Donnell

Ecologists study wildlife behavior to investigate wildlife interactions with the landscape. A common way for ecologists to analyze changes in wildlife behavior is to study their foraging behavior. A common method used to quantify foraging behaviors is measuring the giving-up density (GUD), which is the quantity of food left in a resource patch when the animal stops foraging in that patch. In our study we wanted to determine whether seed removal foraging studies could be biased by scents left behind by human researchers. Our study examined the foraging behavior of the gray squirrel (*Sciurus carolinensis*) in artificial resource patches. We placed foraging bins in the field containing human-scented sunflower (*Helianthus annuus*) seeds mixed into two liters of sand substrate. Our study found that human female-scented seeds had no effect on GUDs, but seeds scented with a male's shirt produced significantly higher GUDs than unscented seeds. Our results suggest that researchers conducting foraging studies should be aware that human male scent might bias seed removal studies by increasing GUDs in wildlife.

5.
EFFECT OF GASOLINE ON THE GROWTH RATE OF THE CYANOBACTERIUM, *ANABAENA*
Jared S.M. Cotton '15, Luke H. Maynard '17
Faculty Sponsor: Craig W. Schneider

Gasoline is a dangerous polluting agent, containing numerous heavy metals such Pb, Zn, Hg, Cu, Cr, Ni, *etc*. Gasoline runoff from roads and stations can damage soils and aquatic environments, as well as the atmosphere. Evidence has been presented that the concentration of hydrocarbons

from motor oil in roadside water can be as high as 10.0 mgl^{-1}, while concentrations in domestic wastewater are around 0.9 mgl^{-1}. Previous findings also show that hydrocarbon uptake from motor-oil depresses the photosynthetic rates of phytoplanktonic microorganisms. This study examined gasoline's effect on the growth rate of the cyanobacterium *Anabaena*. Due to the similarities of hydrocarbons in motor-oil and gasoline, we expected to observe a reduced growth-rate in *Anabaena*. Our results, however, do suggest that gasoline does not have a negative impact on the growth rate of our study organism.

6.

THE EFFECT OF *SERRATE* TRANSMEMBRANE DOMAIN SUBSTITUTION ON *NOTCH* SIGNALING

James Curlin '15
Faculty Sponsor: Robert Fleming

The *Notch* signaling pathway is a crucial means by which organisms are able to differentiate cells during development. *Notch* is regulated primarily through the interaction of a *Notch* receptor protein and a ligand protein, in two specific ways. *Cis*-inhibition occurs when both a ligand and receptor are present on the same cellular membrane. This results in the *cis*-ligand binding to the receptor and preventing the ligand on an adjacent cell from binding and activating the receptor. Alternatively, *trans*-activation occurs when the ligand and receptor are on adjacent cells, and results in the activation of the *Notch* pathway. Both the receptor and ligand proteins are transmembrane proteins that are cleaved first extracellularly by a metalloprotease, and then intracellularly by a γ-secretase. While the cleavages in the receptor protein have been found to be crucial for proper *Notch* activation, the role of the ligand cleavages is much less well defined. It has been postulated that the extracellular cleavage of *Serrate*, a ligand for *Notch*, by a metalloprotease serves as a means of inhibiting *Notch* activation, possibly by affecting the endocytosis of the ligand molecule. By replacing the transmembrane domain of a truncated form of *Serrate* with that region from a non-cleavable human tyrosine kinase receptor *DDR2* (discoidin domain-receptor 2), I show that preventing this cleavage is insufficient toward restoring *Notch* activation. These findings suggest that an additional extracellular 65 amino acid segment near the transmembrane domain may be necessary to restore wild-type levels of Notch activation.

7.

CODON USAGE BIAS IN A4 SUBCLUSTER BACTERIOPHAGES, *M. SMEGMATIS*, AND THE *TUBERCULOSIS* GROUP

Joseph W. DiProperzio '18, Thomas J. Musselwhite '18
Faculty Sponsor: Lisa-Anne Foster

Different species show varying kinds of codon bias, which is the tendency to select a particular synonymous codon more often than other synonymous codons. The purpose of this study was to compare codon bias between thirteen A4 subcluster bacteriophages and five *Mycobacterium* species. The RSCU values were determined for each individual genome and compared to find the most commonly used codons for each amino acid. The most frequently used codon was the same for every species in the study except for the codons used for alanine and valine. There were no significant differences between the RSCU values across all the organisms studied.

8.

EXAMINING THE IMPACT OF NICOTINE ON THE GROWTH OF THE CYANOBACTERIUM SYNCHOCYSTIS SP. IN VITRO

Cameron Driscoll ‘18
Faculty Sponsor: Craig W. Schneider

Tobacco is a highly addictive, carcinogenic plant substance owing to the host of different toxins it contains including high levels of cadmium. Less often considered is the environmental impact of humanity’s nicotine habit. At least 4.5 *trillion* cigarette butts are littered each year by the human beings worldwide. I examined the impact that nicotine has on a species phytoplankton, the cyanobacterium *Synechocystis,* to see if it has an impact on growth in culture. I utilized five treatment conditions: 4 experimental and 1 control. Control conditions consisted (in 4 replicants) of 5 ml of Bold’s Basal medium containing a 0.5 ml of a unialgal culture of *Synechocystis* placed in an incubator at 15˚C and a 16L:8D photo-regime for 12 da. The experimental conditions, using the same growth conditions, were 4, 8, 12 and 16 ug/L of nicotine oil. After 2 wk, the cultures were assessed with fluorometry, measuring chlorophyll b. Many of the 16 ug/L treatment condition tubes grew the fastest, and the least growth was in the other three treatments, however, there was no significant difference between them. This set of results may be due to a lack of effect on growth by nicotine at these concentrations, experimental error, the presence vegetable glycerin in the oil, or because the nicotine had a positive impact on the growth of *Synechocystis* sp.

9.

HOST SPECIFICITY REGARDING *MYCOBACTERIUM TUBERCULOSIS* FOR THE MYCOBACTERIOPHAGE SKIPITT

Khaoula Ben Haj Frej ‘18, Fabiola Yun ‘18
Faculty Sponsor: Lisa-Anne Foster

This research was conducted in an attempt to explore the host-specificity of the newly discovered and annotated phage Skipitt, information noted from research conducted by Jacobs-Sera *et al*.(2013), which claimed only mycobacteriophages within some subclusters of cluster A and cluster K infect *M. tuberculosis*. After all, accumulating an understanding of the predictability of phage-bacteria interaction is crucial, as it allows one to explore options of control for infectious diseases. Thus, while one would expect Skipitt not to infect *M. tuberculosis*, due to its inclusion in subcluster A4, comparative bioinformatics using a phage which infected the bacteria, D29, played a role in proving or disproving this assumption. Consequently, GC content and codon usage, once examined, proved that while use of host may differ among them, there is no doubt that their genomes are extremely similar. On the other hand, pham results, start comparisons, and protein function overlap proved too inconclusive to be used as concrete proof for Skipitt either infecting the bacteria or not. Thus, no conclusion could be made without performing future experimentation involving introducing Skipitt to *M. tuberculosis* and noted whether or not it would infect, a process too dangerous to be performed in a college laboratory, but which would provide one with irrefutable results, in either direction, based on if plaques on *M. tuberculosis* are observed or not as well as by examining further detailed protein comparison between D29 and the entire genome of Skipitt, instead of a select few genes.

10.
EVOLUTIONARY HISTORY FROM MYCOBACTERIOPHAGE D29 TO SKIPITT
Brenna Hobin ‘18, Hannah Shaievitz ‘18
Facuty Sponsors: Lisa-Anne Foster, Thomas McNamara

All isolated mycobacteriophages have been classified into 17 clusters and 30 subclusters based on their genetic relationships. The first documented mycobacteriophage, D29, was isolated in 1954 and is a member of the A2 subcluster. Phamerator was used to trace the evolutionary history from Skipitt, an A4 phage, to D29 using the minor tail protein gene. A phylogenetic tree generated from the tapemeasure protein of previously isolated phages was used as a starting point of where to trace the evolution of Skipitt to D29. The relationships provided a map of what subclusters to compare. From phamerator, it was found that there were strong gene matches between portions of genes 25-30 on all phages investigated. From here, it was inferred that like Skipitt, the minor tail protein for each phage was within this range. The minor tail protein in each phage was found and blasted using NCBI to verify its function. The blast results showed that the minor tail protein is very similar in size in phages within the same subcluster. As the phage evolved from A2 to A3 to A1, the gene got progressively longer in length. However, the evolution from A1 to A4 resulted in a drastic gene length drop. Based on the results, it is concluded that the evolutionary history can be traced from D29 to Skipitt using the minor tail protein. Phage phylogenetic relationships between clusters and subclusters can be determined using single gene analysis.

11.
EXPERIMENTAL ANALYSIS OF WILDLIFE USE OF STONE WALLS IN A NEW ENGLAND FOREST HABITAT
Ben Jaffee ‘15, Jessica Chotiner ‘17
Faculty Sponsor: Scott Smedley

New England is traversed by thousands of miles of stone walls, remnants of its agricultural past. Although there is anecdotal evidence suggesting that stone walls are often used by wildlife, there have been no controlled experiments to investigate this phenomenon. In a mixed-hardwood forest in eastern Connecticut, we used wildlife monitoring cameras to document mammalian and avian use of stone walls, as well as two nearby controls: a wooden structure that provided a potential perching site and a patch of blank forest floor. Two sets (far and near camera proximity to target) of cameras were positioned to capture the movement of large and small animals, respectively. Data were collected from June 2013 to September 2014. Separate Goodness-of-Fit tests on the total number of encounters of all species in the far and near conditions found that, under both conditions, significantly more animals were encountered on the stone wall than on either the wooden substrate or blank controls. We then analyzed the five most abundant species for both the far (i.e., gray squirrel, eastern chipmunk, white-tailed deer, raccoon, and domestic cat, respectively) and near (i.e., white-footed mouse, gray squirrel, eastern chipmunk, Carolina wren, and tufted titmouse, respectively) arrangements. These top-ranking species from both arrangements were typically encountered with significantly greater frequency on the stone wall than on the wooden substrate or blank controls. Our results thus provide the first experimental evidence demonstrating that stone walls are indeed an important wildlife resource. Stone walls may provide forest animals with causeways for movement, shelter, or foraging sites. Given recent findings of the major predatory impact of domestic cats on wildlife, this feline’s use of

stone walls potentially to access forest interiors is reason for concern. Our finds illustrate how human activities, even in the fairly distant past, can influence the ecology of contemporary wildlife.

12.
A MOLECULAR AND MORPHOLOGICAL STUDY OF THE ECONOMICALLY IMPORTANT GENUS *GRACILARIA* (RHODOPHYTA, GRACILARIACEAE) FROM BERMUDA AND FLORIDA

Walter Jongbloed '16
Faculty sponsor: Craig W. Schneider

Taxonomic inquiry of the red algae genus *Gracilaria* remains high with the continuing commercial demand for agars produced within its cell walls. Taxonomic studies based in comparative morphology reveal a high degree of morphological variation within species that presents many obstacles for the identification of species in the genus. Species of *Gracilaria* found in Bermuda include *G. cervicornis*, *G. damaecornis*, *G. mammillaris* and *G. occidentalis*. When the genus *Hydropuntia* was elevated from subgenus, three former Bermuda *Gracilaria* spp. were moved to it: *H. caudata*, *H. cornea* and *H. crassissima*. Phylogenetic and barcode analyses of the Bermuda species are long overdue. High variation among flattened species in the *G. mammillaris* clade supports the use of barcode techniques (mitochondrial COI-5P sequences) for Bermuda specimens. Taxonomic analysis of Bermuda species in this study was extended to include collections from Florida, and sequenced chloroplast *rbcL* genes allowed for a phylogenetic comparison of them. Bermuda DNA sequences reveal the presence of both *G. mammillaris and G. occidentalis* among our samples. Analysis of Florida collections reveals perhaps an extension of the distribution of *Gracilariopsis tenuifrons* and establishes the presence of *Gracilaria venezuelensis, G. damaecornis, G. tikvahiae and G. occidentalis* already known to this area. Genetic sequences of five of the Florida specimens remain at present undetermined and present an area for continued investigation.

13.
INVESTIGATING NOTCH SIGNALING AND SEQUENTIAL SEGMENTATION IN THE FAIRY SHRIMP, THAMNOCEPHALUS PLATYURUS

Sara Khalil '15
Faculty Sponsor: Terri Williams

Segmentation is a key feature of arthropod diversity and evolution. In the standard model for arthropod development, *Drosophila melanogaster*, segments develop simultaneously by a progressive subdivision of the embryo. By contrast, most arthropods add segments sequentially from a posterior region called the growth zone and in a manner similar to vertebrates.

Recent work, mainly focused on insects, suggests that Notch signaling might play a role in arthropods that segment sequentially. These studies document a potential regulatory similarity between sequentially segmenting arthropods and vertebrates. In vertebrates, somite formation involves a molecular oscillator that functions as a pacemaker, driving periodic expression of genes along the anterior-posterior axis.

Here we focus on segmentation in crustaceans, the sister taxon to insects. We investigate the relationship between Notch signaling and segmentation in the fairy shrimp, *Thamnocephalus platyurus*. In order to explore gene regulation of segmentation in these animals, we will be tracing expression of *Notch* pathway genes using *in situ* hybridization and investigating their functions through RNAi knockdown experiments.

14.
DOES GUT FLORA CHANGE IN A MOUSE MODEL OF AUTISM SPECTRUM DISORDERS ON A KETOGENIC DIET?

Shelby Labe ‘16
Faculty Sponsor: Lisa-Anne Foster

The normal bacterial flora of an organism includes the non-disease causing bacteria that inhabit the human body under normal conditions. These bacteria are important for numerous reasons; for example, they excrete vitamins and prevent colonization by pathogens. Autism spectrum disorders (ASD) are neurodevelopmental disorders that can start as early as infancy. They are characterized by difficulties in communication and social interaction, and affect about 1 in 68 children in the U.S. Gastrointestinal (GI) issues are common in ASD and one popular way to alleviate the symptoms is maintaining a ketogenic diet, which is seventy-five percent fat. Such a diet induces ketosis, a metabolic state when ketone bodies, not glucose, are used as the primary fuel. This study analyzes how the ketogenic diet affects the GI flora in a mouse model of ASD and aims to determine if the benefits of a ketogenic diet are correlated with changes in the gut flora. In order to determine the types of bacteria present, the 16s rRNA gene was amplified from the fecal samples of mice in treatment groups. The amplified DNA was then digested with restriction enzymes (*Hae*III and *Mnl*I) and terminal Restriction Fragment Length Polymorphism (tRFLP) chromatograms were generated. Analysis of the chromatograms will determine if there is a difference in diversity of the bacteria present in the ketogenic diet samples versus the no diet samples and then more specifically compare the abundance of each strain.

15.
DIVERGENCE BETWEEN MYCOBACTERIOPHAGE SKIPITT AND ITS CLOSEST RELATIVE

Carina Leggio ‘18, Julia Pitino ‘18
Faculty Sponsor: Lisa-Anne Foster

The study objectives were to determine which A4 cluster mycobacteriophage is Skipitt’s closest phage relative and determine how many years ago Skipitt and this relative diverged from one another or from a common ancestor.This study is significant in that relating a timescale to the mutations of closely related A4 cluster phages can be telling as to how this group of phages will continue to evolve over a particular period of time. Seven A4 phages closely related to Skipitt were chosen based on their high alignment scores with many genes of Skipitt found in preliminary Blasts. Skipitt’s tape-measure gene was Blasted (phages.db) against the seven selected phages to specifically compare the alignments of their tape-measure genes. Identity values were analyzed to find the closest relative of Skipitt and a published rate of mutation in bacteriophages was implemented to calculate the number of years since the divergence of Skipitt and this relative. In this study we found that the phage Medusa is Skipitt’s closest relative (with respect to the tape-measure gene) and the two phages diverged 2649 years ago. These results

suggest strong conservation of Skipitt and Medusa as viable individual species since the time of their divergence. The results also give a general idea of the amount of time it takes for a number of mutations to accumulate between two generations of phage.

16.
DIFFERENTIATING BETWEEN THE A SUBCLUSTER PHAGES
Mary Ruth Nagel '18, Madison Ochs '18
Faculty Sponsor: Lisa-Anne Foster

The Cluster system separates phages into various groups, denoted by a letter, and each Cluster has a number of subclusters that further identify and distinguish the phages. We sought to determine what differentiates A subclusters, and whether there was one definitive characteristic that denoted clustal assignment, or if it was a subjective decision based on a variety of criteria gathered during experimentations. We plotted five A Cluster phages against each other in a Phamerator phage map and used the results to analyze nucleotide similarity and relatedness across subclusters. We utilized the "Compare" feature on the Mycobacteriophage Database and compared plaque photographs and electron microscopy photographs from the subclusters. We also consulted previously conducted research and publications to compile additional information. The Phamerator phage maps illustrated a high degree of similarity within the same subclusters, and a minimal amount of similarity between different subclusters. Similarities that transcended subclusters were in specific genes and pertained to the protein or gene function of the nucleotide sequence or amino acids in question. Our research indicated a strong difference between A subclusters. We also found that plaque morphology and electron microscopy images are inconclusive in determining phage subcluster assignment.

It was found that determinations of Cluster and subcluster are made based on a variety of evidence. It is a fairly subjective decision that requires scientific evidence and data to support final assignment. Subcluster A4 has its own unique characteristics, such as number of open reading frames, repressor binding sites, and nucleotide sequences. Each of these pieces of evidence contributes to the Cluster and subcluster assignment, but must be weighted differently and considered in various contexts.

17.
A MOLECULAR-ASSISTED ALPHA TAXONOMIC STUDY OF TWO GENETIC SPECIES OF *DASYA* (RHODOPHYTA, DASYACEAE) IN BERMUDA
Phong Kim Quach '17
Faculty Sponsor: Craig W. Schneider

Genetic sequencing and phylogenetic analysis utilizing a portion of the *rbc*L chloroplast gene revealed two genetic species of red algae collected in 2012 in Bermuda, *Dasya cryptica* put. sp. nov. and *Dasya*_sp.01_Bda. Both Bermuda genetic species displayed similar morphological features to *D. anastomosans*, an Indo-Pacific red alga (type locality = Indonesia), necessitating the need for a critical anatomical/morphological comparison of these algae. *Dasya cryptica* sequences grouped more closely with *D. anastomosans* than *Dasya*_sp.01_Bda. After collecting anatomical data from the two Bermuda entities and specimens of *D. anastomosans* from the Indian Ocean, we found only minor differences between *Dasya* sp.01_Bda and *D. anastomosans*, and no significant morphological differences between *D. cryptica* (hence the species name

selection for this entity) and the Indo-Pacific species. The investigation concluded that *D. cryptica* and *Dasya* sp.01_Bda were two undescribed species in the genus closely related to *D. anastomosans*. Our findings raised interesting questions about the biogeography and historical distribution of these genetically related species in the Indo-Pacific and western Atlantic oceans that will require further investigation.

18.
SHAKEN NOT STIRRED: POSSIBLE EFFECT OF AERATION ON *MICROCYSTIS AERUGINOSA* (Microcystis, Cyanobacteria)
Erica Quinones '16, Kathy Rodogiannis '17
Faculty Sponsor: Craig W. Schneider

Rapid growth and accumulation of phytoplankton can lead to harmful algal blooms which in effect cause toxicity, fish kills, food web alterations, deoxygenation of water and a general decline in water quality. Cyanobacteria such as *Microcystis aeruginosa* are notorious for causing harmful toxic blooms. Turbulence is a regulatory factor in algal bloom proliferation and cyanobacteria are especially sensitive to water column stability and vertical stratification as they lack motility.

Our experiment focused on the effects of turbulence on *Microcystis aeruginosa* growth. Cultures grown on an orbital shaker at 150 rpm were compared to stagnant (non-shaken) cultures. Nutrient levels were varied to determine a possible relationship between nutrient concentration and aeration in *M. aeruginosa* growth. Cultures were grown in Bold's Basal medium at 15 °C for seven da. Growth was estimated using an AquaFluor fluorometer set for phycocyanin florescence units. No significant difference was found overall between shaken versus stagnant cultures, nor between the various nutrient levels. It is possible that excessive aeration occurred, resulting in the observed rapid population crashes. Therefore, it could be inferred that excessive turbulence inhibits photosynthetic activity and growth.

19.
IDENTIFICATION OF GENES IN THE NOTCH SIGNALING PATHWAY AFFECTING WING PATTERNING IN *DROSOPHILA MELANOGASTER*
Kathy Rodogiannis '17
Faculty Sponsor: Robert Fleming

Notch signaling and the genes involved in the pathway are essential to the development of a variety of structures in a wide range of organisms. Wing development of the fruit fly, *Drosophila melanogaster,* depends on the correct regulation of cell survival, growth, proliferation, differentiation, and pattern formation. Many of these properties are regulated by Notch signaling. We generated an artificial expression system that over-activates Notch in the wing and generates a wing vein loss phenotype. To locate additional genes involved in Notch signaling, we carried out a mutagenesis screen to identify F_1 dominant suppressors or enhancers of the over-activated Notch wing phenotype. To date we have obtained four suppressor lines that modify the phenotype. We have mapped three of these lines to particular chromosomes in the fly and are investigating the genes that mediate these effects.

20.
PREDATION, INJURY, AND BRAIN CELL PROLIFERATION IN WEAKLY ELECTRIC FISH
Michael Ragazzi ‘16, Geoffrey Keane ‘16, Hannah Adams ‘17
Faculty Sponsor: Kent Dunlap

Much speculation has been aimed at the relationship between predation and cell growth within the brain. Predation and risk of predation have been thought to decrease brain cell proliferation, however there has only been limited examination of this interaction in field conditions. This study observed the weakly electric fish, *Brachyhypopomus occidentalis,* in 3 drainages across Panama, 3 high predation locations with elevated levels of the predatory catfish *Rhamdia quelen,* and 3 low predation locations. Fish were obtained from each site and sacrificed. The brains were frozen and transported back to the laboratory for analysis. The brain was labeled with an antibody for PCNA a transcription factor for cell division and new cells in the fore and midbrain were quantified to determine rate and density of new cell proliferation. Weakly electric fish that were previously injured, 10-45% tail injury, displayed significantly lower levels of brain cell proliferation. This result was confirmed by later laboratory experimental research which also demonstrated a decrease in brain cell proliferation in fish that had undergone an amputation. Additionally, it was shown that non-injured fish in high predation locations also had significant declines in newborn cell density compared to fish present in low predation locations. Brain cell proliferation differences were only significant in the forebrain, promoting the idea of localized addition or repression in the brain region associated with learning, fear, and spatial orientation. This study determined the presence of a localized decrease in forebrain cell proliferation in response to predation threat and injury and suggests a causal relationship between these factors.

21.
ANALYSIS OF THE UPPER RESPIRATORY TRACT MICROBIOME IN ASTHMATIC CHILDREN
Abigail Whalen ‘15, Catherine Guariglia ‘14
Faculty Sponsor: Lisa-Anne Foster

Normal flora is the diverse microbiota that inhabits the human body and has been seen to play a role in the modulation of inflammation, where the greater richness and abundance of the normal flora causes less inflammation.

Asthma is a chronic inflammatory disease that affects the upper respiratory tract significantly causing shortness of breath, wheezing, and chest tightness. Asthma affects people of all ages, but often begins in early childhood and is quite prevalent in urban areas.

This study was conducted to see if there were any differences in the normal flora of the upper respiratory tract in children with asthma compared to healthy children. Samples were collected at Connecticut Children’s Medical Center in Hartford, Connecticut. The samples were analyzed using 16s rRNA gene amplification and tRFLP chromatographs were used to determine the abundance and diversity of the flora. Cloning of PCR fragments to plasmid vectors were used to sequence the samples and determine specific genus or species trends across the sample groups.

tRFLP results suggests that children with asthma have significant changes to the normal bacterial flora of the upper respiratory tract and sequencing results supports this with finds of clear and unique differences in bacterial species and genera found in both sample groups.

22.
CAFFEINE'S EFFECT ON THE CHLOROPHYLL B PRODUCTION OF *Ankistrodesmus.*

James H. Whelan '16, Scott J. Buchanan '17
Faculty Sponsor: Craig W. Schneider

Water pollutants are not only traces of common fertilizing substances such as nitrogen, potassium and phosphorus. Prescription drugs and over the counter medication residues also are found in water habitats near developed areas. Many are introduced to lakes, ponds, and streams when improperly disposed; these drugs often flushed down toilets in the event they are unused by medical patients. Also, many medications exist in quantities that cannot be completely absorbed into the human body and the excess is expelled in the forms of urine and feces into the water treatment process. A common compound often found post water treatment is caffeine, a substance found in commonly consumed beverages and stimulants in many forms such as in coffee, tea, workout enhancing supplements and energy drinks in order to stimulate biological activity in a person. Caffeine has been considered by the FDA to be relatively safe at doses less than 500 mg per day. Although many studies have been performed on the performance of human activity under the influence of caffeine, very few studies have explored its effect on aquatic organisms, in particular algae. In this experiment, a green algal species of *Ankistrodesmus* was observed under several caffeine concentrations (30, 60, 10, 150, 200, 250, and 300 ppm) over a 6-day period to determine the effect of caffeine on the alga's biological activity. The cultures were grown in Bold's Basal medium in 15°C temperatures with a 16L: 8D photoregime. Triplet control and experimental cultures of each concentration were made, and growth was measured daily with a fluorometer measuring Chlorophyll B concentrations to estimate growth under each set of conditions. Results revealed that caffeine had no effect on chlorophyll concentrations of *Ankistrodesmus*. It is hypothesized that the decline in chlorophyll B concentrations was due the acclimation of the algae to a new growing medium.

23.
INVESTIGATING A POTENTIAL GENE FUNCTION OF MYCOBACTERIUM PHAGE

Fabiola Yun '18
Faculty Sponsor: Kathleen Archer

A bacteriophage is a virus that parasitizes a bacterium by infecting it and reproducing inside it. Among these, mycobacteriophage is a group of bacteriophages that specifically target *Mycobacterium* as their hosts. Over 500 mycobacteriophage genomes were sequenced as of 2014, yet only 10% of gene functions in Mycobacteriophage genomes are known. The unknown gene functions can be investigated by genetically modifying the phage genome and by observing the effects on phenotype. We can create a desired mutant by replacing the original gene of a phage with a defective gene. This recombination of phage genome will be achieved by adding genes that encode exonuclease (gp60) and recombinase (gp61) to the bacterial host genome. Gene 60 and gene 61 are contained in plasmid pJV53. First, plasmid pJV53 must be inserted into

Mycobacterium smegmatis as wild-type *M. smegmatis* does not contain pJV53. To do this, plasmid pJV53 was purified and *M. smegmatis* cells capable of taking up DNA were prepared. We performed multiple experiments to transform *M. smegmatis* with pJV53; however, the transformation was not successfully completed. The possible reasons include the method of sterilizing glycerol, the size of cuvettes, and the ratio between the cells exposed and the concentration of pJV53 during the electroporation. As the bacteriophage infects *M. smegmatis* that contains the recombination plasmid, the new gene sequence with a defective gene at the targeted site will be introduced to the phage. It is expected to observe some differences in plaque morphology after a gene in the phage is artificially mutated. The plaque morphology and growth characteristics will enable us to determine the possible gene function.

CHEMISTRY

24.
DEVELOPING MASS SPECTRAL RECOGNITION PATTERNS FOR CHARACTERIZATION OF RESINS AND BINDERS IN ARTISTS' MATERIALS
Jacqueline Busa ‘17
Faculty Sponsor: Henry DePhillips

Conservators are able to repair original works as well as determine if a work is counterfeit through the analysis of the materials present in a painting. Direct Analysis in Real Time–Time of Flight Mass Spectrometry (DART-TOF MS) was used to investigate two components of easel paintings. One resin, dammar, and one binder, walnut oil, were studied first as pure components, then in mixtures. Each material studied was aged using heat. Materials were aged until no further change was noted. A mass spectrum was collected every 48 hours for each sample. Mass spectral recognition patterns were identified for each pure sample, and these m/z profiles were used to identify walnut oil and dammar resin in aged mixtures.

25.
SYNTHESIS OF ANTIBIOTIC TURBOMYCIN ANALOGUES FOR BIOLOGICAL ACTIVITY EFFECTIVENESS
Briana Chang ‘16, Ifeanyi Okoh ‘15
Faculty Sponsors: Lisa-Anne Foster, Cheyenne Brindle

The general overuse of antibiotics has resulted in resistance and has increased a demand for understanding drugs that will enhance bacterial death. In 2002 Gillespie discovered a new antibacterial known as turbomycin providing a new starting point to solving antibacterial issues. In our lab we have synthesized several turbomycin compounds with altered hydrogen bonding, electron donating and electron withdrawing abilities, as well as other variants, in hopes of understanding the drug’s biological activity with Gram-postive and Gram-negative bacteria. Although all of our analogues have not been biologically tested, products made with 1-naphthaldehyde and 3-ethyl-indole were found to effectively kill *bacillus subtillis* (a Gram-positive bacteria) at concentrations as low as 25 mg/mL. The effectiveness of these analogues may indicate that electron-donating functional groups, despite their presence in different parts of the structure, have a beneficial impact on activity. Many analogues currently suffer from poor water solubility, requiring the use of dimethylsulfoxide as a co-solvent. By increasing the ability of the analogues to interact with water through hydrogen bonding, we hope to mitigate this

problem. Future work will explore this possibility with further analogues that probe the electronic properties necessary for antibiotic activity and explore the impact of steric hindrance along with solubility enhancement.

26.
PHOTOCHEMISTRY OF THE LIQUID VAPOR INTERFACE
Julia Clapis '18
Faculty Sponsor: Maria Krisch

The liquid-vapor interface is ubiquitous in our lives, yet the chemistry that occurs there is not fully understood. For reactions occurring at this interface, the rate of chemical reactions can be affected by a chemical's surface propensity. The incomplete solvent cage present at the interface also affects this rate. For reactions that occur when exposed to light, there is also reason to suspect an increased rate of photolysis in reactions with chemicals with increased surface concentrations.

A droplet train with either a 30, 50, or 75 nm orifice with a piezoelectric ceramic is used to produce tiny droplets that mimic atmospheric aerosols. An aqueous solution, currently ethyl iodide, is pumped through the droplet train, and reacted with an ultraviolet light. The gas phase products are then analyzed in the gas phase with a mass spectrometer.

Understanding the reactions that occur at the liquid vapor interface is essential to the understanding of aerosols in atmospheric chemistry. Different chemistry that occurs at interfaces can have a measurable effect on the rate of reaction in aerosols with large surface areas.

27.
INHALER TECHNIQUE INSTRUCTION USING A VIDEO IS AS EFFECTIVE AS MANUAL DEMONSTRATION FOR IMPROVING INHALER TECHNIQUE IN MEDICAL RESIDENTS
Gunjan Gupta '15
Rakesh Gupta, MD

As healthcare providers are the main source of patient education, provider knowledge is crucial in teaching proper inhaler technique to patients. We sought to assess inhaler technique in internal medicine residents and assess the efficacy of educational intervention. Two educational tools were used: manual demonstration by a pulmonologist versus an online video (www.use-inhalers.com) during a didactic teaching session for internal medicine residents at a community hospital. Of the 35 residents, 13 received a manual demonstration and 22 received the video instruction. Inhaler technique was assessed, by one author who was blinded to before and after instruction, by video recording the inhaler use and scoring 1 point for each of the 11 steps performed correctly. Total inhaler scores were expressed as mean ± SD and analysis was done using t-tests. Post instruction scores were significantly improved in both groups. Pre/post inhaler scores with manual demonstration were 6.54 ± 1.51 and 9.85 ± 1.41 ($p=0.000002$) and with video instruction were 6.09 ± 1.76 and 9.43 ± 2.21 ($p=0.00009$). Change in inhaler score with manual demonstration (3.31 ± 1.38) and video instruction (3.35 ± 3.37) was not significant ($p=0.48$). Most medical residents were unable to use a MDI correctly, however, one educational session was highly effective and most residents were able to achieve a good to perfect technique.

Instruction using an online video can effectively substitute manual demonstration without any impact on quality, while saving on time resources used.

28.
CONSTRAINT OF PEPTIDE CONFORMATION USING TUNGSTEN-ALKYNE COMPLEXES

Paul R. Handali ‘18, Joseph P. Sanderson-Brown ‘18
Faculty Sponsor: Timothy P. Curran

Tungsten is a transition metal with the capacity to form air stable complexes with alkyne ligands. It can be coordinated to dialkynyl peptide ligands to form metallacyclic peptides. Prior work has shown that these metallacyclic peptides are not constrained to a single conformation. The object of this study is to complete the characterization of a series of tungsten dialkynyldipeptide complexes. The first dialkynyl peptide to be examined is a derivative of dilysine, where the alkyne is appended to the side chain amine groups. In the first step commercially available Boc-Lys-OMe was reacted with propargyl chloroformate to produce Boc-Lys(Poc)-OMe. Some of the Boc-Lys(Poc)-OMe was reacted with LiOH to yield the carboxylic acid Boc-Lys(Poc)-OH. The remainder of the Boc-Lys(Poc)-OMe was treated with trifluoroacetic acid to produce the trifluoroacetate salt of H-Lys(Poc)-OMe. Next the Boc-Lys(Poc)-OH was linked to H-Lys(Poc)-OMe using the coupling reagent HATU to make the dilysine derivative Boc-Lys(Poc)-Lys(Poc)-OMe. The reaction products were purified using flash chromatography. The structures of the reaction products were confirmed using electrospray mass spectrometry and proton NMR spectroscopy In the next step, the resulting dialkynyl peptide, Boc-Lys(Poc)-Lys(Poc)-OMe will be coordinated to tungsten to form the metallacyclic peptide. The tungsten complex will be analysed using NMR to identity the different conformations of metallacyclic peptides that have formed.

29.
PREPARATION AND EVALUATION OF LARGER ORGANOMETALLIC β-SHEETS BASED ON A DIPHENYLACETYLENE CORE

Woojung (OJ) Ji ‘15
Faculty Sponsor: Timothy P. Curran

In this poster, I will present the progress of my undergraduate thesis work. The objective of my research is to synthesize a hexapeptide derivative incorporating 2-amino-2’-carboxy diphenylacetylene and to coordinate this peptide to tungsten via alkyne-metal bonding to probe whether the complex retains a β-sheet conformation. The peptide derivative is prepared by linking two tripeptides, each attached to either 2-ethynylaniline or 2-idodobenzoic acid, which will be coupled in a Sonogashira reaction. The structural confirmation and the β-sheet conformational analysis of the final product will be performed using ^{1}H Nuclear Magnetic Resonance (NMR) spectroscopy. The 2-dimensional ^{1}H NMR experiment, Nuclear Overhauser Effect Spectroscopy (NOESY), helps identify the close interaction between protons through space, and this allows for the conformational analysis of the product. Also, a ^{1}H NMR DMSO titration experiment that helps identify intramolecular hydrogen bonding between the amide NH proton on one chain and the amide C=O oxygen atoms on the other further aids in the analysis. This work would indicate whether a large peptide derivative with the diphenylacetylene core could be synthesized and whether it retains a β-sheet conformation after being coordinated to

tungsten. It would also give scientists with new ways to study β-sheet models and provide further understanding of the conformational behavior of alkynylpeptides coordinated to tungsten.

30.
DETECTION, CHARACTERIZATION AND QUANTIFICATION OF "BATH SALTS" IN ORAL FLUID IMPLEMENTING NOVEL INSTRUMENTATION: DIRECT ANALYSIS IN REAL TIME-TIME OF FLIGHT MASS SPECTROMETRY
Heather S. Loring '15
Faculty Sponsor: Janet F. Morrison

Synthetic cathinones, commonly known as "bath salts", are synthesized by altering substituent groups on the scheduled drug, cathinone, thereby changing the chemical enough to elude prosecution on the grounds of preexisting legislation. As a consequence, these designer drugs persist as legal alternatives to scheduled amphetamine derivatives and render commonly implemented screening techniques useless because the drugs change constantly. Cathinones are beta ketone amphetamines that act similarly to other amphetamine type drugs, such as Ecstasy. These legal derivatives of the scheduled drugs stimulate the central nervous system by triggering the release of catecholamines.

In this study, direct analysis in real time-time of flight mass spectrometry (DART-TOFMS) was evaluated for the rapid and reliable quantitative analysis of "bath salts" in oral fluid. Results on the detection, characterization, and quantification of nine representative cathinones in saliva will be presented. Direct analysis of fortified oral fluid samples using both manual and automated sampling approaches will be compared with sample preconcentration using solid phase microextraction (SPME). The application of the method to fortified samples acquired with commercial oral fluid collection devices will be presented to demonstrate feasibility for roadside testing.

31.
DIRECT ANALYSIS IN REAL TIME–TIME OF FLIGHT MASS SPECTROMETRY FOR THE DISCRIMINATION OF COUNTERFEIT FROM AUTHENTIC SILDENAFIL CITRATE
Matthew Lucas '17
Faculty Sponsor: Janet Morrison

Recently, drug counterfeiting has exploded worldwide, causing pharmaceutical companies to lose significant amounts of revenue. It also poses serious medical risks to patients due to the unknown and often dangerous composition of these knock-offs. Some of the most widely counterfeited drugs are those used to treat erectile dysfunction, such as Viagra (sildenafil citrate), with knock-offs abundantly available on the Internet. Clearly, reliable analytical methods that rapidly screen for drug authenticity are needed. This particular study evaluates the potential of direct analysis in real time–time of flight mass spectrometry (DART-TOFMS) for the differentiation of counterfeit from authentic sildenafil tablets. DART-TOFMS is non-destructive, does not require sample preparation, and provides instantaneous results. The results of preliminary experiments to characterize the chemical signatures of authentic and counterfeit sildenafil tablets will be presented. DART ion source temperature, mode of sample introduction,

and ionizing voltage will be explored to maximize sensitivity and selectivity in the analysis of solid, crushed, and dissolved tablets.

32.
COMPUTER ASSISTED DRUG DESIGN: TOWARDS THE DISCOVERY OF NEW ANTIBIOTICS

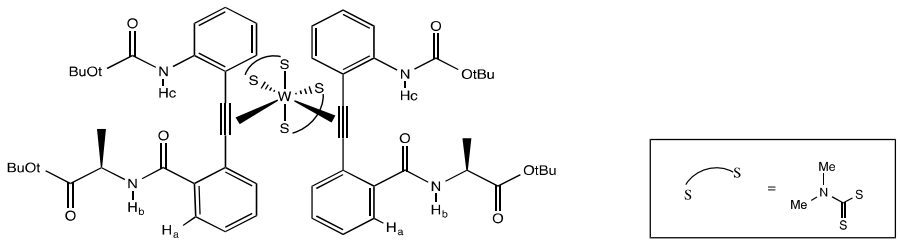
Lauren Ollerhead '18
Faculty Sponsors: Vindya Thilakarathne, Amy Anderson PhD, University of Connecticut

Drug resistant bacteria infections caused by species such as *Pseudomonas aeruginosa,* have become an increasing threat to recent public health. Our project aims to utilize computational tools to discover new drug molecules that target antibiotic resistant bacteria. Zinc binding enzyme LpxC , plays a vital role in the formation of bacterial cell wall and has been a major target in novel antibiotic drug development. A small library of ligand molecules was docked into the substrate-binding pocket of LpxC enzyme using the SYBYL docking software. The docked enzyme-ligand system was then examined using PYMOL to verify enzyme-ligand binding interactions. PYMOL is a visualization software that allows us to observe which amino acids in LpxC are interacting with the docked ligand molecule. The information is used to identify the importance of specific functional groups of the ligand molecule and key features of the LpxC substrate-binding site.

33.
PEPTIDE DERIVATIVES OF 2-AMINO-2'-CARBOXYDIPHENYLACETYLENE REMAIN β-SHEETS WHEN COORDINATED TO TUNGSTEN

Elena-Marie Pedro '17
Faculty Sponsor: Timothy P. Curran

β-sheet proteins and their aggregation in cells are areas of study due to apparent associations with the incidence of such neurodegenerative diseases as Alzheimer's disease.[1] Studies using chemical models of β-sheet proteins may provide information needed to understand these proteins. Previous research has shown that peptide derivatives of 2-amino-2'-carboxydiphenylacetylene adopt an anti-parallel β-sheet conformation.[2] The two objectives of this research are: (a) to investigate whether these peptide derivatives maintain their β-sheet conformation when one of the diphenylacetylenes coordinates to the transition metal tungsten to yield a mono-alkyne complex and (b) to investigate whether a tungsten bis-alkyne complex **(1)** could be synthesized and whether the complex would retain the β-sheet arrangement. Results collected indicated that the peptide portions of the synthesized mono-alkyne complexes maintained their β-sheet conformation[3] and that a tungsten bis-alkyne complex **(1)** could be synthesized. Details regarding the synthesis, purification and coordination of the peptide derivatives of 2-amino-2'-carboxydiphenylacetylene peptide to tungsten will be presented.



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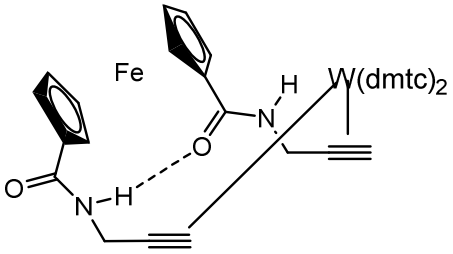
34.

EXPLORING WHETHER A NOVEL MACROCYCLE CONTAINING IRON AND TUNGSTEN CAN BE USED TO NUCLEATE A β –SHEET

Niranjana Pokharel '15
Faculty Sponsor: Timothy P. Curran



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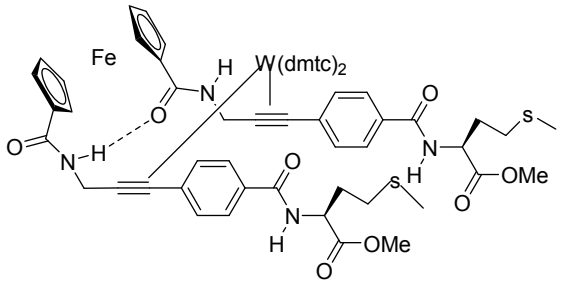

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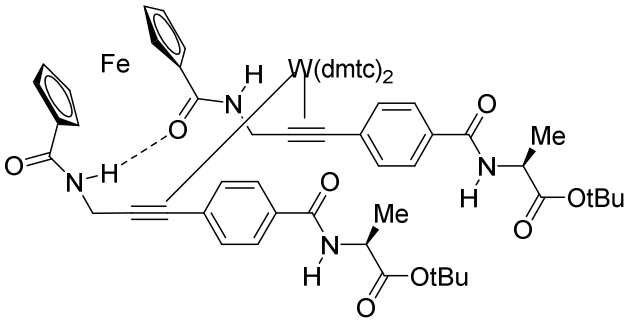

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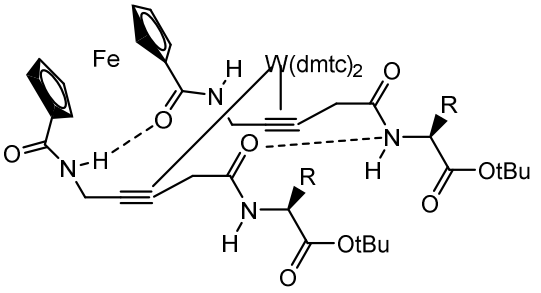


4

The use of organometallic compounds in modeling protein β-sheets may provide a novel means of studying secondary protein structures, which have been implicated in a number of diseases, such as Alzheimer's. It might be possible to use a molecule with a rigid conformation to hold two peptide chains in close proximity so that a β-sheet structure is obtained. Previously, dialkynylpeptides were complexed to tungsten, forming novel metallacyclicpeptides featuring a cyclic tungsten bis-alkyne complex. Most of these complexes were found to be flexible about the tungsten-alkyne bond. This posed the question of whether all cyclic tungsten bis-alkyne complexes would be flexible. In 2010, Lawrence synthesized complex **1,** a bimetallic ring system

with a ferrocene unit at one end, and a tungsten bis-alkyne complex at the other end. In order to explore whether peptides attached to the alkynes in **1** will adopt a β-sheet conformation, two metallacyclicpeptide complexes were synthesized: complex **2**, which includes the amino acid alanine, and complex **3**, which includes the amino acid methionine. Both amino acids are linked to the macrocycle via a p-disubstituted benzene. Conformational analysis shows that the ring systems in **2** and **3** are identical to the ring system in **1**. Addition of the p-disubstituted benzene and the amino acids did not change the rigid ring structure. DMSO titration experiments shows that the amide NH of the amino acids in **2** and **3** are not involved in intramolecular hydrogen bonds. Current work centers on the synthesis of a new metallacyclic tungsten complex, **4,** similar to **2** and **3,** except that in **4** the p-disubstituted benzene is replaced by a methylene. The results from these studies will be presented.

35.

INVESTIGATING LIQUID-VAPOR PHOTOCHEMISTRY OF IODIDE AND CHLOROIODOMETHANE WITH X-RAY PHOTOELECTRON SPECTROSCOPY

Jeff Pruyne ‘15
Faculty Sponsor: Maria Krisch

Interest in the liquid vapor interface stems from differences in behavior compared to the bulk. The liquid-vapor interface’s properties, such as reactivity, composition, pH, are often different from the bulk liquid below it. The photochemistry of iodine/iodide in the atmosphere is linked with several radical reactions including ozone depletion. Understanding the changes in composition and photochemistry at the liquid-vapor interface would lead to a better understanding of atmospheric cycles, and the nature of the liquid-vapor interface. X-Ray Photoelectron Spectroscopy (XPS) allows the concentration of different components to be measured in a liquid solution as a function of depth. Changes between the interface and bulk were measured using XPS. Measurements of several different components in solution of both CH_2ICl and KI were investigated.

36.

SYNTHESIS OF TURBOMYCIN ANALOGUES FOR THE DEVELOPMENT OF NEW ANTIBIOTICS: VARIATION OF THE INDOLE COMPONEN

Phong Kim Quach ‘17, Christine Reavis ‘15, Ifeanyi Okoh ‘15, Briana Chang ‘16
Faculty Sponsors: Cheyenne Brindle, Lisa-Anne Foster

The upsurge in the number of antibiotic resistance bacteria in addition to the lack of new antibiotics stressed the need for novel antibacterial agents. In 2004, turbomycin B, which was isolated from a soil microorganism, was discovered to have antibiotic properties, making it a potential candidate as a new drug. Our research goal is to determine the structure-activity relationship of turbomycin B based on the results of structural modifications in the indole portion of the molecule on the biological activity. Thus far, we have successfully synthesized N-methyl, N-tosyl, and N-acetyl derivative precursors. Moreover, we are optimizing the synthetic protocol for 5-carboxylic acid indole derivatives. Additionally, multiple serial dilutions of the N-methyl, N-tosyl derivative precursors in DMSO and water were tested on *B. subtilis*, *E. coli*, *S. aureus*. In the future, we plan to test all analogues on different bacteria and use the activities to guide our efforts in making a more active compound.

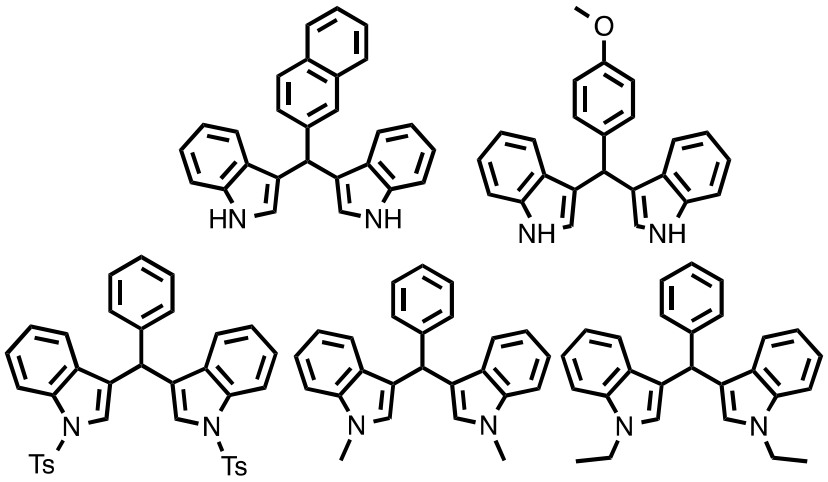
37.

SYNTHESIS OF TURBOMYCIN ANALOGUES FOR THE DEVELOPMENT OF NEW ANTIBIOTICS TO BE TESTED ON MODEL ORGANISMS

Christine Reavis '15
Faculty Sponsor: Cheyenne Brindle

The globe has entered an antibiotics crisis, with compounds that have been effective for years ceasing to work. This problem is further compounded with a significant drop off in the number of new antibiotic compounds. This dual problem has lead researchers to develop novel compounds that can help fight the resistance problem. Turbomycin A and B are natural products isolated from soil microbes by Gillepsie et al. that were found to have antibiotic activity against both Gram positive and Gram negative bacteria. To determine the antibiotic activity of turbomycin, for future optimization studies, analogues have been synthesized and tested on model organisms. The synthesized analogues modify both the indole component of the molecule and the phenyl component of the molecule, altering the electronics and sterics to identify which regions are important for the molecule's bioactivity. Initial findings suggest that some of the analogues (figure 1) have similar antibacterial effects to turbomycin. Some analogues showed activity at concentrations as low as 25.0 μg/ml, but not all showed antibacterial activity on model organisms, such as Bacilis subilis. Some antibiotic differences between analogues have been identified but more work is needed to determine the exact differences in antibiotic activity. For example, The N-ethyl was shown to be effective and the napthaldehyde was seen to only have partial inhibition. The next step is to determine the lowest possible concentration that still induces antibiotic activity. Additionally, we hope to determine the mechanism of action the compounds have that enable their antibiotic activity.

Figure 1: Analogues synthesized and tested on model organisms



38.

THE EFFECTS OF A 3-WEEK KETOGENIC DIET ON THE PURINERGIC NNEUROCHEMISTRY IN MICE

Jacob Rubin ‘15, Michelle Dyer ‘16
Faculty Sponsor: William H. Church

Previous research from this lab has indicated that a three-week ketogenic diet (KD) increases dopaminergic activity in the motor and somatosensory cortices of adult mice. ATP and adenosine (the major neuroactive purine compound found in brain) have been implicated in the therapeutic effect of the KD and the purine system is known to modulate dopaminergic activity. Samples from the previous study were analyzed for purines to determine if any correlation existed between dopaminergic and purinergic neurochemistry. A high performance liquid chromatography (HPLC) method for determination of purine compounds in discrete brain regions was developed and used to quantitate the purine compounds. Separation parameters were optimized for the quantification of adenosine, hypoxanthine, xanthine, and inosine. The current study found that the three-week chronic KD significantly reduced the ratio of the dopamine metabolite DOPAC to adenosine in the nucleus accumbens. This result supports previous literature regarding interaction between the dopaminergic and purinergic neuronal systems and suggests a possible involvement of the purinergic system in modulating dopaminergic activity in the cortex of mice fed a KD.

39.

INVESTIGATING THE STABILITY OF SYNTHETIC AND NATURAL ZWITTERIONIC LIPID COATINGS IN POLYDIMETHYLSILOXANE MICROFLUIDIC DEVICES THROUGH CONDUCTIVITY MEASUREMENTS AND FLUORESCENCE

Livia Shehaj ‘15
Faculty Sponsor: Michelle L. Kovarik

Supported bilayer membranes (SBMs) have been used to coat capillaries and microfluidic devices as a way to prevent non-specific adsorption of proteins, DNA, and other biomolecules on channel walls. Combined with the small dimensions of microfluidic devices, such coatings are an optimal tool for biological and biomedical research. Hybrid PDMS-glass devices were prepared in order to characterize the stability of different lipid coatings. Conductivity measurements were performed on straight 3 cm channels, and the presence and stability of the SBMs were characterized based on the electroosmotic flow. The difference in stability between a synthetic and natural zwitterionic lipid was investigated. Data indicated that the synthetic lipid coatings were more stable than the natural lipid coatings, suggesting that the chain length and saturation play a role in the packing of these SBMs. Electroosmosis measurements of the two lipid coatings were relatively stable for 2-4 hours (RSD 8-18%) when a constant electric field was applied. At longer time points these measurements reached that of a bare chip, indicating that the coating had been disrupted. A second method exploring the use of fluorescence microscopy for characterizing these SBMs was employed to investigate the variability seen in the conductivity measurements. Preliminary data indicate that the noise came from the method rather than the chip-to-chip variability. The fluorescence method is now being used to confirm the difference between the two zwitterionic lipid coatings.

40.

IN PURSUIT OF PEPTIDE DERIVATIVES OF CYCLIC TUNGSTEN BIS-ALKYNE COMPLEXES DERIVED FROM 1,1'-FERROCENEDICARBOXYLIC ACID

Edgar Soto '15
Faculty Sponsor: Timothy P. Curran

In prior work, this lab has demonstrated an ongoing interest in the formation of rigid constrained tungsten-bis(alkyne) complexes (Lawrence, 2010) formed from the coordination of ferrocene dialkynyl analogs to tungsten. In an effort to constrain peptide chains with derivatives of these rigid complexes, peptide derivatives of 1,1'-ferrecenedicarboxylic were formed. The dialkynyl derivative of 1,1'-ferrocenedicarboxylic acid was formed by a reaction with 1,4-butynediol. NMR spectroscopy experiments as well as mass spectrometry experiments confirmed its formation. Reaction of the dialkynyl product with $W(CO)_3(dmtc)_2$ has, so far, not produced the desired bis(alkyne) complex. As a result the dialkynyl derivative was then reacted with an N-acyl derivative of the amino acid L-alanine in order to try and form an alkynyl peptide derivative. In this presentation details about this work will be discussed.

41.

THE APPLICATION OF ANALYTICAL TECHNIQUES IN ART CONSERVATION

Sarah Talcott '17
Faculty Sponsor: Henry DePhillips

A number of analytical techniques have been developed for the determination of resins, binders and pigments, both organic and inorganic, in artifacts, in particular, easel paintings. Typically, those methods require that the sample be modified (solubilized, derivatized) and given that samples taken from easel paintings are very small, treatment usually means loss of the original sample. Hence, any technique that permits direct analysis of sample components with no prior treatment is preferable. Direct Analysis in Real Time, Time of Flight, Mass Spectrometry (DART-TOF-MS) is a mass spectrometric method in which samples do not require pretreatment. In this study, this technology is used to develop m/z profiles for aged resins, binders and mixtures. The results of this research will help art conservators identify binders and varnishes in authentic easel paintings before they begin their restoration work.

42.

ANALYSIS OF SYNTHETIC CATHINONES USING STIR BAR SORPTIVE EXTRACTION COMBINED WITH DIRECT ANALYSIS IN REAL TIME-TIME OF FLIGHT MASS SPECTROMETRY

Kathryn Tully '16
Faculty Sponsor: Janet F. Morrison

Synthetic cathinones, commonly known as "bath salts," are a class of designer drugs that are often marketed as legal alternatives to Ecstasy. However, the growing prevalence of synthetic cathinones has prompted the enactment of state and federal regulations restricting their use and distribution. The recent restrictions have promoted a need for the development of sensitive and reliable analytical methods for their detection in biological samples. The current study investigates the use of stir bar sorptive extraction (SBSE) combined with direct analysis in real time – time of flight mass spectrometry (DART-TOFMS) for the detection and quantitative analysis of synthetic cathinones in oral fluid. The target cathinones in this study include

butylone, diethylpropion, flephedrone, mephedrone, methedrone, methylenedioxypyrovalerone, methylone, ethylone and naphyrone. Preliminary data comparing SBSE extractive phases (polydimethylsiloxane (PDMS) vs. ethylene glycol/PDMS copolymer) and sample introduction modes for DART-TOFMS will be presented.

43.
THE MEASUREMENT OF PROTEIN KINASE B (PKB) AND PEPTIDASE ACTIVITY IN *DICTYOSTELIUM*
Kunwei Yang '17, Allison J. Tierney '17
Faculty Sponsor: Michelle L. Kovarik

Protein kinase B (PKB) is an enzyme involved in cell proliferation under stress. In human cells, aberrant PKB activity is implicated in many cancers, making PKB an important target for further research. We are studying PKB in *Dictyostelium*, a social amoeba that has highly conserved protein kinase B signaling pathways similar to those in human cells. We plan to measure PKB activity in *Dictyostelium* lysates using the peptide VI-B, a fluorescently labeled substrate for PKB. Because peptide substrates are at risk of degradation by peptidases, we are conducting degradation assays to measure the stability of VI-B in addition to performing phosphorylation assays. The results of these assays are measured by capillary electrophoresis with laser-induced fluorescence (CE-LIF). This semester, we have optimized a buffer (100 mM borate, 15 mM SDS, pH 11.4) for separation and detection of VI-B and the enzymatic products of peptidases and PKB. Current degradation assay results show that VI-B has a half life of at least two hours in a 3 mg/mL total protein lysate; this suggests that VI-B is a stable enough peptide for phosphorylation by PKB to occur. Future work includes determining a reproducible half-life for VI-B, comparing degradation of VI-B as a function of the cell life cycle, and measuring the phosphorylation kinetics of VI-B in *Dictyostelium* lysates.

COMPUTER SCIENCE

44.
TRYCODE
Christine Boyle '15
Faculty Sponsor: Ralph Morelli

TryCode is a web application designed for high school students who have an interest in Computer Science, connecting with others, and creative exploration. The purpose of TryCode is to build a community of coders, so users of the site are able to create a profile, upload a coding project, view others' coding projects, send and receive feedback/bug reports, and update their code. Additionally, users of the site have access to help forums where they can post questions and answers on a variety of computer science related topics. Finally, female students have the option of joining the TryCode Women's Mentoring Network where they are able to contact a mentor who can provide guidance and support throughout their studies and early career.

45.

EMAIL FILTER
Angel Castromonte '15
Faculty Sponsor: Takunari Miyazaki

Spam emails are not only an annoyance, but they are also a means by which many people have their personal information stolen or become victims of financial fraud. Since there is no filter that can perfectly determine which emails are spam and which are not, new techniques are still being developed to improve email filters. This project attempts to improve email filters by carefully selecting the characteristics of emails to be taken into consideration when determining if an email is spam or not. The goal of this project is to identify new characteristics of spam that can be used to both enhance the performance of spam filters and further research in spam identification and removal.

46.
HYPERGRAPH PARTITIONING ON GPUS AND IMAGE CLASSIFICATION
Hyunsu Cho '15
Faculty Sponsors: Peter A. Yoon, Lin Cheng

This project is aimed at building an intelligent piece of software that automatically classifies a set of pictures into multiple categories. Its main contribution is to accelerate a state-of-the-art algorithm known as hypergraph partitioning. Hypergraphs capture similarities among groups of neighboring pictures and help guide classification decisions. Since it takes a lot of computations to partition a hypergraph, this project seeks to accelerate the partition process using a commodity hardware known as Graphics Processing Units (GPUs). Originally designed for graphics-intensive applications, GPUs are known to deliver good performance at an affordable price range. The poster discusses how the project addresses the challenges in adapting the partitioning algorithm to GPUs. In particular, the massively parallel nature of GPUs is highlighted: a given task must be divided into small independent pieces in order for that task to perform well on GPUs.

47.
CIQ APP
Destin Dopwell '15
Faculty Sponsor: Ralph Morelli

Throughout the course of a music student's life, he or she will take a series of composition identification exams. In these exams, the student is required to name various compositions based on short excerpts of music from the respective pieces. These exams are particularly challenging due to the lack of efficient means of preparation. The Composition Identification Quizzer (CIQ) App was developed to solve this problem. The CIQ application consists of a mobile app and a web app. After uploading music onto the CIQ web portal, users are able to stream the uploaded music onto their devices. Random excerpts of the piece are played which the user must use to identify the composition. Streaming in this format will help the user prepare for the actual exam, as this type of playback will simulate exam conditions.

48.

ACCELERATING MATRIX COMPUTATION ON GPU

Hormenou Ebenezer ‘18, Bemnet Demere ‘18
Faculty Sponsor: Peter Yoon

Matrix computation is one of the widely used tools in data computations such as image processing, image identification, behavioral predictions and many more. Traditionally, matrices were computed sequentially on CPUs. This implies that the run time for the computation increases with the size of the matrix. The problem that arises with processing a matrix with a CPU is that, the bigger the size, the more it is difficult to complete the task in a short amount of time. The GPU(Graphics Processing Unit) seems more suitable to process matrix data. In fact, the GPU, unlike the CPU has thousands of processors working in parallel originally meant for graphics purposes. However in recent years the power of GPUs has been extended to computing any type of data using CUDA C, a parallel computing platform designed by NVIDIA. To test that GPUs are in fact more efficient in computing matrix data, a multi-GPU parallel algorithm of matrix-matrix multiplication is implemented on four GPUs. Given two matrices, the first matrix is divided row-wise into four smaller matrices of equal size. The resultant smaller matrices are then copied to the global memories of each individual GPU while the other matrix is copied in its entirety. A kernel launch on each GPU computes the dot product of each row of the smaller matrices with each column of the second matrix. All the dot products are then saved into a resultant matrix. Matrix multiplication tests are then ran on the CPU and on the GPU using large matrices with columns and rows greater than 10 000, our GPU implementation ran about twenty times faster. This implies that the GPU can be more powerful in any problem that involves the repetition of common computational steps. Further work will be directed towards more complex matrix computations.

49.

FANTASY FOOTBALL PLAYER RANKER

Jake Hyland ‘15
Faculty Sponsor: Madalene Spezialetti

When football season comes around, millions of football fans prepare themselves for the upcoming season of fantasy football. It is estimated that over 19 million people across the United States participate in some kind of online fantasy football league, but how do these fantasy owners know which players are the best selections for their teams? This project focuses on ranking every player in the NFL based on their projected fantasy football statistics. It uses an algorithm that makes use of each player’s statistics from previous seasons. It’s goal is to rank the players as accurately as possible, taking all possible factors into consideration. This ranker accounts for certain factors that existing algorithms may not account for, such as age and injury proneness. The end result will be a numbered list of players, ranking them from best to worst in terms of their projected fantasy output for the following season.

50.

STOCK OPT
Jason Katz ‘15
Faculty Sponsor: Madalene Spezialetti

The stock market is fluctuating constantly, with changes going on every second of the day. As a result, people want information on the stock market at their disposal 24/7. However, this valuable information costs money. Stock Opt will give people all of the benefits of the information on the stock market without any cost for the information. Stock Opt is a mobile application for the android platform that allows users to search for stocks of specific companies. Stock Opt also allows the user to create stock portfolios which store the user’s stocks for later viewing purposes and to add and delete stocks from the portfolio.

51.
ANALYZING DRIVERS BASED ON ANDROID PHONE DATA
Joe Magardino ‘15
Faculty Sponsor: Takunari Miyazaki

This project explores the use of cell phone technology to monitor driving behavior and rates the safety of drivers based on the data collected. The applications of this process are endless and can be useful to insurance companies, owners of fleet vehicles and concerned parents with new young drivers. Using the Hadoop distributed file system to handle the potentially massive amounts of data collected and applying supervised machine learning tools, this project analyzes information such as speed, gps, and accelerometer data collected from an Android smart phone to classify a driver as either dangerous or safe.

52.
EVENTSHOWCASE
Ryan Nelson ‘15
Faculty Sponsor: Madalene Spezialetti

In the past, photo albums acted as gateways into our past. Today, phones and tablets can capture and hold those cherished memories. EventShowcase is a mobile application for Android that strives to fill the void in digitally crowd-sourcing photography at physical events. Hosts can create location and date specific events, invite guests, and contribute images within the application. App users in the vicinity of an event can take and upload photos to a central server and vote on their favorite images from other participants. After the event ends, the top images are shared in a slideshow to preserve the most captivating depiction of the occasion. The project was developed using Eclipse with Android Development Tools and tested on a Nexus 10 tablet.

53.

MANY RANDOM GRAPHS ARE EXPANDER

Yicheng Shao ‘16, Peter Reheis ‘16
Faculty Sponsor: Takunari Miyazaki

In practice, it is often desirable to construct graphs that are highly connected and yet sparse. When used in networks, such graphs allow many nodes to communicate with one another using least resources. Expander graphs are families of sparse graphs that have strong connectivity properties. In addition to networks, expander graphs are also useful in coding theory, cryptography, and complexity theory, to name a few.

In general, graphs’ high connectivity demands a short distance between any two vertices; on the other hand, their sparseness requires having few edges overall. These two notions sound contradictory to one another; indeed, many sparse graphs are not highly connected, and many highly connected graphs are rather dense. However, the mere existence of expander graphs can be easily proved by a simple probabilistic argument. Not surprisingly though, explicit construction turns out to be a very difficult task.

The main objective of this project is to study the spectral properties of expander graphs. One common way to measure the quality of connectivity is to use the second largest eigenvalues of the adjacency matrices of graphs. To efficiently compute such eigenvalues, we considered the power method, an iterative approximation method with guaranteed convergence. We implemented this method and computed such eigenvalues under varying degrees of tolerance. We compared the results with those computed by the Matlab’s eigenvalue function. For our purposes, the power method turned out to be far more efficient than Matlab’s function, thus allowing us to work with larger graphs.

It is well known that, theoretically, many random graphs are expander. We computed the second largest eigenvalues of randomly generated 3-regular graphs. (In such graphs, each node has exactly three neighbors.) We found that, up to manageable sizes, very large percentages of such graphs are indeed expander.

54.

POKEMON SHOWDOWN, A WEBSOCKET APPLICATION ON SHOWDOWN

Nicky Thai ‘15
Faculty Sponsor: Madeleine Spezialetti

Showdown is a popular web-based Pokemon competitive battling simulator that was created in 2011, attracting thousands of users and millions of visits every month. The Showdown Android project brings the gaming experience to Android platform in order to expand the user experience as well as to attract new users. The project contains two major components, a server side and a client side. First, the project solves various issues regarding web socket on Android, including connection consistency, memory management, and design pattern. Second, the project publishes an Android application that allows users to connect to Showdown’s socket server and play with both web and mobile users. The Android application supports the majority of features available on the web application, including battlefield, animation, chat room, and various other utilities.

ENGINEERING

55.
IMPROVING A SHOCK TUBE DIAPHRAGM CUTTING SYSTEM
Tasha Adams ‘18, Andrew Agard ‘18, Victor Korir ‘18
Faculty Sponsor: John Mertens

Diaphragms in circular shock tubes are more prone to tearing than diaphragms in contact with flat edges when cut during shock tube experiments. In order to address this problem as economically as possible a design process was carried out that identified and analyzed alternative solutions to the problem. An elegant solution was synthesized that consisted of a 3D printed plastic circular ring that would fit into a facet machined into the end of the shock tube. Currently the part has been rendered in SolidWorks and 3D printed after numerous sketches and incremental prototypes. The end of the shock tube needs to be machined and then the driver section of the shock tube needs to be transported outside for outdoor testing of the diaphragm. Fixing the diaphragm tearing will prevent the diaphragm from interfering with shock tube experiments. A new support structure will be used to conduct outdoor shock tube experiments modeled using a reaction mechanism and open source software.

56.
DESIGN OF AN AUTOMATED CAR SEAT TO REDUCE HEATSTROKE DEATHS OF CHILDREN LEFT UNATTENDED IN CARS
Riley Cahill ‘15, Bryan Wolfe ‘15
Faculty Sponsor: John D. Mertens

Since 1998, 633 children in the U.S. have died from heatstroke because they were left unattended in a hot car [1]. This averages one child dying every 9.6 days. The National Highway Traffic Safety Administration issued a report in July 2012 concluding the technology to remind caregivers about a child left in the car is not sufficient to prevent these deaths [2]. Problems with the current devices include batteries going low, not hearing the alarm, and the amount of immediate action required of the caregiver to save the child’s life. The goal of this project is the design of a device that reduces the number of children who die of heatstroke in cars per year. The design is an aftermarket device that can also be easily incorporated into the manufacturing process of a car seat.

Two main goals shape the design of the car seat. Each goal is centered on a unanimous theme of significance in the prevention of heatstroke fatalities of children in cars. The goals of the design are to constantly monitor the car scenario and alert the driver if there is a child heat stroke fatality. Together these goals comprise a system that continuously monitors a car for an unsupervised child’s presence and takes action upon confirmation of that presence. Monitoring refers to the detection of an unsupervised child in a car and the continuous monitoring of the temperature within the vehicle. The top priority of the car seat system is to accurately detect the presence of a child in a car seat. Once the presence of a child in the car is confirmed, the system’s priority is to record the temperature within the vehicle and rapidly relay that information to a processing system.

The second major goal of the design is an alert system in place that takes action in a potentially dangerous situation. The initial alert system includes an immediate tone recognizing a child is unattended. The secondary alert system communicates with the parents of the child and, if necessary, the authorities, using standard text messaging notifications.

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57.

SOLAR-POWERED STERILIZER FOR SURGICAL INSTRUMENTS

Christian T. Firsching '15, Benjamin C. Williams '15
Faculty Sponsor: J. Harry Blaise

Sterilization of surgical instruments is required to prevent infection and the spread of disease. Common sterilization methods require electricity, however rural clinics in developing nations often do not have access to dependable electricity. These clinics are responsible for providing healthcare to three billion people worldwide, nearly half the population.

This project consisted of the design and fabrication of a compact, user-friendly, and high quality solar sterilization system. The system consists of an evacuated tube solar collector set at the focal point of a parabolic reflector. A microcontroller tracks temperature and displays sterilization status. Also accommodated in the design is a regular AC power option for when access to electricity is made available.

The system effectively sterilizes surgical instruments under dry heat in accordance with the guidelines of the Centers for Disease Control (CDC).

58.

MECHANICAL CONTROL SYSTEM DESIGN FOR F4U-4 FLIGHT SIMULATOR

Binod Giri '15, Elizabeth E. Jessep '15, Shaun K. Smith '15
Faculty Sponsors: John D. Mertens, Craig McBurney

Connecticut Corsair is a volunteer organization with an ultimate goal of restoring an F4U-4 Corsair aircraft. Currently, the organization is working in a consortium with Trinity College, the University of Connecticut and the University of New Haven to build a flight simulator that can be used to train Corsair pilots. This year, our senior design team focused on designing a mechanical control system for the simulator, which consists of a control stick and rudder pedals. Before designing the mechanical control system, existing flight documents were consulted to gain a complete understanding of the mechanical control system of an actual Corsair aircraft. Based on this information, several alternative designs were proposed and analyzed.

The major design goal of our project was to provide the simulator pilot with the realistic flight experience. In order to achieve this goal, our system needed to be able to provide variable resistance opposing the motion of rudder pedals and control stick. Our system also needed to sense the motion of these parts in order to alter visual display in the simulator. The control stick and rudder pedals were designed to include these features. Our final design consists of linear actuators, servo motors, springs and encoders assembled in a way that meets the specifications required by the consortium. The design minimizes the number of individual elements and can be easily installed. Our system is also able to interact with the flight simulator "brain" and respond accordingly. This poster explains our final system and the design process.

59.
ROBOTIC FINGER
Patrick Norton '15, Lisa Yamada '15, Yun Gong '15
Faculty Sponsor: Taikang Ning

In the human body, finger movement is the result of from muscle action manipulated through a series of electrical impulses controlled by the brain and its versatility affects every aspect of our daily life. Designing an electrical-mechanical system that can perform a finger's fine movement presents a multi-disciplinary challenge, and it's the design focus of the underlying project. Many parts used in this project were in-house designed and fabricated. Belts and pulleys are used to mimic finger joints; servo-motors are used to emulate muscle actions. Servo-motors are activated via a series of pulse-width-modulation signals generated by an embedded microprocessor. The completed finger system has three joints and is capable of moving side to side and forward and bending joints. Each joint can rotate up to 90° while the side-swing is up to 50°. Gripping pads are attached to increase friction when holding objects. Most in-house fabricated parts were designed using Solidworks CAD tool and manufactured using a 3D printer. The whole action of this finger-like system is to be controlled by user-designed programs. We have written programs to demonstrate the following actions: playing notes on a keyboard, holding a small object while in a curled position, and holding but not crushing an egg. These demonstrations illustrate that the fingers are capable of not only a strong grip but a delicate grip as well.

60.
ROBOBOAT
Anthony Redamonti '15, Nathan Corwin '15, Pratistha Shakya '15
Faculty Sponsor: John Mertens

This project endeavors to design and build an autonomous robot capable of competing in the Association for Unmanned Vehicle Systems International (AUVSI) foundation's annual international 2015 RoboBoat competition. A team of Trinity class of 2014 engineering students started the RoboBoat project to build a boat following the guidelines for AUVSI foundation's annual international RoboBoat competition. The robot was designed to accomplish tasks such as obstacle avoidance, speed testing and autonomous travel. However, by the end of the year, many of the team's promised goals were unmet. For this project, essential RoboBoat components and hardware from last year's model will be used, but the team will redesign the robot exploring alternative designs and methods. This project endeavors to continue the previous work of students from the class of 2014 while also presenting new design challenges. New mechanical

designs were implemented to increase the maneuverability of the boat, and highly intricate programming skills were necessary to develop the software architecture necessary for the boat to complete its tasks. The work this team has done was not derivative, but rather original design and problem solving enhanced by an existing knowledge base. Our primary objective is to make a robot capable of competing in the 2015 RoboBoat competition with additional objectives of redesigning and enhancing existing designs and adding the capability of completing bonus challenges in the competition.

61.
DESIGN AND IMPLEMENTATION OF INTELLIGENT DIGITAL STETHOSCOPE
Dana Wensberg ‘18, Deven Roberts ‘18, Mariam Avagyan ‘18
Faculty Sponsor: Taikang Ning

A prototype intelligent digital stethoscope capable of collecting a heart sound signal and displaying its waveforms on an LCD was designed and implemented. The stethoscope takes an analog input (sound) and converts it to a digital format, allowing the processor to analyze the data and display the waveform. A basic heart sound analysis algorithm was written in MATLAB, capable of identifying and isolating S1 and S2, as well as finding and determining the length systole and diastole. The circuitry of the prototype, including a signal amplifier and filter, was consolidated onto an external circuit board for ease of demonstration. The motivation for this project is that traditional auscultation exhibits inconsistency due to individual’s personal experience. A digital stethoscope employing modern technology can provide objective analysis to assist diagnosis of heart condition.

ENVIRONMENTAL SCIENCE

62.
ANALYSIS OF THE EFFECTS OF CLEARCUTTING ON SOIL ON THE WHITE MOUNTAINS
Cassia Armstrong ‘18, David Johnston ‘16
Faculty Sponsor Jonathan Gourley

In past studies, a positive relationship has been found between the percentage of organic materials in soil and concentrations of mercury. However, studies have also shown that less densely forested areas are also correlated to increases in mercury concentrations. In clear cutting, these observations seem to contrast each other, as forest loss means more exposure to airborne fallout, but also decreases in organic content. In determining how clearcutting specifically affects soil in regards to organic/inorganic materials, and mercury concentrations over time, loss on ignition (LOI) tests as well as mercury analysis using a direct mercury analyzer (DMA) were performed on soil samples. Three locations on the White Mountains with differing geographic qualities were used for this study, from which 35 plot points each were chosen. Soil samples were obtained from each plot point and freeze dried so that no moisture remained in the samples. Three LOI tests were run for each sample. To do this, small amounts of soil were added to weighed crucibles until the crucibles were filled about three quarters. The masses of the crucibles containing the soil was measured, then the crucibles were placed in a furnace and heated to 500°C for an hour after 100°C was reached, then 1000°C for an hour after 100°C was reached. The masses of the crucibles were found following each burn. For the DMA tests, small nickel

boats containing between 0.01 and 0.02 grams of soil were run through the machine. This study is a comparison of results overtime, so conclusions cannot be made just yet whether or not there will be a significant change in the soil due to clearcutting. The final results will be shared with the USDA Forest Service, and help develop environmentally friendlier clearcutting methods in the future.

63.
USING STELLA TO MODEL DEFORESTATION IN THE AMAZON RAINFOREST
Guadalupe Barajas '17
Faculty Sponsor: Jonathon Gourley

The practice of clearing large areas of forest for a variety of products and agriculture has become common practice in modern day's consumer industry around the world. In the Amazon rainforest, deforestation has become common practice in order to clear land for ranching, mining, and agriculture. This large clearing of areas has become common practice in places such as the Amazon Rainforest and has become known as deforestation. Using STELLA modeling, the correlation between deforestation and atmospheric carbon dioxide concentrations was modeled. The model results will show that there is an inverse correlation between deforestation and atmospheric carbon dioxide concentrations. The data show the positive feedback loop between cutting down trees and concentrations of atmospheric carbon dioxide, where less trees means more carbon dioxide in the atmosphere.

64.
PLANT DIVERSITY AT THE KNOX PRESERVE IN STONINGTON, CONNECTICUT
Lupita Barajas '17, Adam Hammershoy '17, Greg Reardon '17
Faculty Sponsor: Cameron Douglass

The Knox Preserve is a 17 acre plot of land located in Stonington, CT that is managed by the Avalonia Land Conservancy. There are a number of plant species growing there, both invasive and native.

During numerous sampling trips throughout 2013 and 2014 plant species that could be definitively identified in the field were recorded, and specimens of unidentifiable species were collected and brought back to campus. Unknown species specimens were pressed and dried, and these specimens used for subsequent identification using several printed botanical keys, and also Gobotany.com. The identified plants were then added to the master plant species list.

From the Knox Preserve, there were 33 different families of plants found. The most common family of plants found at the site was Poaceae.

From the plants collected for the study, there were 36 introduced species, 54 native species, and 6 introduced/native species. There were 45 forbs, 17 graminoids, 10 monocots, 1 moss, 7 shrubs, 5 trees, 8 vines, 3 shrubs/trees, 1 forb/herb, 2 forbs/vines, and 1 forb/shrub/vine. Using the information from the study, a descriptive, legible guide book of the plants at the Knox Preserve was created for use in future studies at the site.

65.

THE EFFECT OF CLEAR CUTING ON SUB-ALPINE FUREST SOIL NUTRIENT CONCENTRATIONS OF ALUMINUM AND CALCIUM WITHIN THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE

Justin Beslity ‘15, Lauren Tierney ‘16, Jack Agosta ‘17
Faculty Sponsors: Jonathan Gourley, Robert A. Colter (Soil scientist from USDA Forest Service, White Mountain National Forest)

Clear-cutting is the most popular and economically profitable method of logging and has been in use for centuries to provide lumber. However, there are several negative side effects which may lead to an increase in soil erosion and key nutrient loss. Aluminum and calcium have been found to be critical nutrients for forest ecosystems. Aluminum is an important nutrient for plant growth, especially for trees, and a deficiency in calcium could result in root degradation, leaf necrosis and inability to properly produce flowers and fruit. Collaborating with the USDA Forest Service, three small timber sales were selected for long-term study, which would be sampled for measurements of aluminum and calcium in the O and B layers of the soil. Samples were collected prior to the cutting of the timber sales to measure baseline soil nutrient content of the three plots in the summer of 2013, and samples were collected one and two years after the initial sampling depending on the plot in order to analyze changes in soil nutrient concentrations. The Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) is used to measure the concentrations of aluminum and calcium in the soil. Geographic Information System (GIS) is used to provide several interpolated maps of each timber sale. In order to confirm the accuracy of results and to compare future nutrient concentrations, samples with high deviations above ten percent or concentrations observed to be orders of magnitude higher or lower than expected, were reprocessed. The reanalyzed samples were then selected based off of precision and accuracy. To date, all three sites have been sampled and processed for baseline soil nutrient levels. All three sites have been revisited after their clear cut but only one site has been completely analyzed after the clear cut.

66.

EFFECTS ON THE TIDAL CYCLE STELLA MODEL

Vincent Gandolfo ‘17, Carl Gibney ‘16
Faculty Sponsor: Jonathan Gourley

We use our STELLA to model the flow between high and low tides in the Bay of Fundy, Nova Scotia. The tidal measurements are recorded by the Fisheries and Oceans official website. We were able to create a STELLA model that simulated the tidal cycle represented by inflows and outflows from sea level. At almost every coast in the world, there is a high and a low tide twice a day. The rotation of the earth causes this daily cycle of the tides. But there is also a monthly cycle, involving the moon’s rotation around the earth. Therefore, we measured our model over the time period of a month. The moon’s position relative to Bay of Fundy (daily) and the moon’s position relative to the sun (monthly) account for the two forces acting on sea level change at the coast of Bay of Fundy. We took what we know about the moon pulling on ocean water and data from the Fisheries and Oceans website to determine the magnitude of these two sets of flows acting on sea level. However there is a less significant force on sea level that is strictly human induced. Humans increase the amount greenhouse gases in the atmosphere. Increased greenhouse gases in the atmosphere cause the earth to warm and this melts glaciers. The melting of glaciers increases sea level and this has a direct effect on the tides. We have data that measures the sea

level rise at the Bay of Fundy per year and in order to measure the sea level rise per month, we will divide this data by twelve.

67.
SOIL CARBON GRADIENTS AT KNOX PRESERVE, MYSTIC, CONNECTICUT
Emily Hamilton '17, Jordan Fisk '17, Tracy Keza '17
Faculty Sponsor: Cameron Douglas

Invasive plants are known to cause widespread ecological disturbances that can lead to reductions in biodiversity and change soil properties. For example, invasive plant species can alter soil carbon-nitrogen ratios because of their abundant biomass production and tissue chemistries. This project sought to characterize chemical and physical properties of soils collected across a habitat gradient - from an open grassland to a dense shrubland - at the Knox Preserve, near Mystic, Connecticut. Between fall 2013 and spring 2014, 867 soil samples were collected every 2.5 meters along transects following the prevailing habitat (and elevation) gradients. Samples were analyzed for soil moisture and carbon content using the loss-on-ignition method, and a soil conductivity meter was used for measuring soil salinity.

Soil moisture levels did not differ significantly (mean = 24.82%) between habitat types (forested vs grassland), but there were higher moisture levels at the northern edge of the grassland near a small pond. Organic carbon levels from forested soils were 47% higher ($P < 0.05$) than grassland soils. Carbon levels in forested soils were more positively correlated ($R^2 = 0.40$, $P < .0001$) with soil moisture than carbon levels in grassland soils ($R^2 = 0.13$, $P < .0001$). Soil salinity levels were dramatically higher in samples collected surrounding the pond (mean = 142.03 mS/cm). There was a significant difference between the organic carbon in the wetlands (mean = 14.46 mS/cm) compared to the transitional habitats (mean = 11.78 mS/cm). Salinity levels were significantly ($P < 0.05$) higher in samples collected from the grassland habitat (mean = 119.46 µS/cm) compared to the shrubland habitat (mean = 0.12 µS/cm). Changes in elevation within the Knox Preserve explain the variation in salinity levels. Further studies will be carried out this coming year to analyze nitrogen levels in relationship to carbon levels.

68.
ANALYSIS OF HOURLY GROUND TEMPERATURE DATA ON THE TRINITY COLLEGE CAMPUS, HARTFORD, CONNECTICUT, USA
Lia Howard '15
Faculty Sponsor: Jonathan Gourley

A long term observational study has been constructed on the campus of Trinity College in Hartford, Connecticut to record local variations in ground temperatures. Since 2007, six submerged temperature probes at depths between 10 and 240 centimeters have recorded temperature every hour in a well beneath the Trinity College athletic fields. Averages of the first and last quartiles s monthly temperature data display a slightly increasing linear trend over the past seven years of records. These increases are consistent for all probes at each depth. Using the averages of the first and last quartiles of each month's data minimizes the influence of anomalous temperature extremes throughout the data set. These results suggest that the changing global climate has had a measurable warming effect on local ground temperatures in central Connecticut over the last seven years.

69.
HUMAN IMPACTS ON THE NITROGEN CYCLE
Camden Howe ‘16
Faculty Sponsor: Jonathan Gourley

Using STELLA, I modeled the nitrogen cycle by incorporating sinks, inflows, outflows, and converters to produce a model that would show the impact humans have on the nitrogen cycle. In this model the sinks consist of atmospheric nitrogen, aquatic nitrogen, terrestrial nitrogen and terrestrial biomass of nitrogen. The difference between terrestrial and terrestrial biomass of nitrogen is in terrestrial nitrogen the nitrogen in question is not incorporated by biological means while terrestrial biomass consists of the biological nitrogen content in terrestrial organisms. The nitrogen cycle is in a steady state without human interactions, however this model shows what effect that humans have on the nitrogen cycle. The increase in biological nitrogen due to fertilizer, and the deforestation cause an increase in runoff, which causes the aquatic nitrogen sink to increase over time. Atmospheric nitrogen decreases due to an increase in nitrogen fixing bacteria added by crops with higher nitrogen fixing bacteria planted by farmers to increase the nitrogen in the terrestrial and terrestrial biomass nitrogen sinks. Terrestrial and terrestrial biomass sinks remain relatively constant due to runoff and an increase in nitrogen fixing bacteria that have a cancelling effect to have a neutral impact. This study, however, does not take into account what the shifting of nitrogen between the nitrogen sinks has on organisms that live in, or rely on the nitrogen in these environments.

70.
EXPANDING SEA ICE AND THE ICE-ALBEDO FEEDBACK IN THE ANTARCTIC MODELED USING STELLA
Ben Jaffee ‘15
Faculty Sponsor: Jonathan Gourley

There has been considerable news coverage in recent months about the incredible speed at which the West Antarctica ice cap is melting. This has come amid record highs in surface and sea temperatures in the region. While the land ice has been melting, however, sea ice has been expanding, reaching a record extent in 2014. The reason for the expanding sea ice is not precisely known, but one theory is that the melting land ice is diluting the ocean waters off the coast of Antarctica with fresh water. This causes the freezing temperature of the water to increase, thus allowing for the water to freeze more easily in the winter months. In theory, this expanding sea ice extent would cause the overall albedo in the Southern Ocean and Antarctica to increase. The ice-albedo feedback, in this case, is negative feedback loop, as warming temperatures lead to increased land ice melt, desalinating the oceans and leading to increased ice coverage in the winter, raising albedo and cooling the Antarctic. A model of this feedback process was constructed using STELLA. The model shows a possible explanation to the expanding sea ice in the Southern Ocean around Antarctica, and a mechanism that keeps Antarctica from warming as fast as the rest of the globe.

71.
AFRICAN ELEPHANT (LOXODONTA AFRICANA) POPULATIONS IN AMBOSELI NATIONAL PARK, KENYA
Tracy R. Keza '17
Faculty Sponsor: Jonathan Gourley

The populations of the African bush elephants (*Loxodonta africana*) have been decreasing at an alarmingly high rate. It's been expected that at this current rate, this species of elephants will be extinct within in the next 15-20 years. The majority of the African elephant population can be found in East Africa, with the majority in Kenya and Tanzania. Two factors that caused such a deficit in these populations are poaching for to sell these tusks on the black market and human encroachment of the land. The extinction of the African elephant would be an ecological disaster because they are keystone species. With the help of a mathematical modeling system, STELLA, I created a model that simplifies the understanding of the complex ecological interactions of the African elephant and the ecosystem, and how these factors affect the overall health and population of these species. This model will serve a purpose to make a prediction on the and how to restore these populations to a steady state if they decline

72.
MODELING THE WALKER CIRCULATION THROUGH STELLA
Shaina Lo '15, Rosangelica Rodriguez '15
Faculty Sponsor: Jonathan Gourley

On March 5th of this year, the National Oceanic and Atmospheric Administration (NOAA) announced the arrival of the El Niño. It is important to study this system and its weather patterns in order to measure major shifts that may affect natural and global phenomenon. In California, for example, a stronger El Niño may cause even worse droughts than experienced previously. El Niño is caused by a weakening of the Walker Circulation. Using STELLA, a computer software utilized to create earth systems, we added perturbations to our Walker Circulation to model an El Niño effect. Because the Walker Circulation is an ocean based system, our model focused on the patterns of water movement in its different phases. Our model was made more accurate by incorporating precise data from different online weather sources. With a finished model, we are able to provide other students with a basis to further develop this system. Our goal was to produce a steady state model of the Walker Circulation that could potentially be used by others to further study El Niño/La Niña weather patterns.

73.
AQUATIC CYCLE OF MERCURY IN THE EVERGLADES- USING STELLA
Sun Ho Ma '16, Daniel Pidgeon '16
Faculty Sponsor: Jonathon Gourley

The Everglades have the highest average concentration of mercury in Florida. Over the past century, the rate of mercury deposition from the atmosphere has increased five-fold, which impacts nearly 300 different species of fish and damages the fragile ecosystem as a whole. Mercury can enter an ecosystem in a variety of ways including atmospheric wet deposition, atmospheric dry deposition, stormwater runoff, and groundwater discharge. We use STELLA to model the mercury system specific to the Everglades to find equilibrium states and current levels

of the system. STELLA will show us what aspects of the mercury cycle relationship are responsible for the spike in mercury levels that the Everglades has been experiencing over the past century. Using the Everglades Interim Reports and other studies on the Everglades, we depict the Everglades mercury cycle with accurate reservoir volumes and flux rates to find equilibrium. The rapid atmospheric deposition rates are the primary focus of the perturbations to the mercury concentration in the Everglades. Mores specifically, elemental mercury is the prime focus of the atmospheric deposition. The sources of elemental mercury in atmospheric deposition are the leading cause of atmospheric mercury entering the food web and causing the increased levels of mercury. The impacts of the increase in atmospheric deposition are modeled through the transformation of mercury into methylmercury in ecosystems. Methylmercury is responsible for the toxicity component as it bioaccumulates up the food chain and damages the species' nervous systems and brain function. This impacts not only the ecosystems' health, but humans as well.

74.

USING STELLA SOFTWARE TO MODEL SEA ICE MELT AND ITS AFFECT ON POLAR BEAR POPULATIONS

Hadley Merrill '17, Celeste Popitz '17
Faculty Sponsor: Jonathan Gourley

Polar bears are animals that rely heavily on arctic ice sheet coverage for habitat, reproduction, hunting, and overall survival. The effects of melting ice sheets have been known to cause a rapid decrease in polar bear population. It is assumed that as the ice sheets begin to melt quicker, due to global temperature increases, that polar bear populations will decrease more rapidly as well. Melting sea ice is a positive feedback loop, where the low albedo of sea water (compared to the high albedo of sea ice) causes surface temperatures to increase, which in turn melts more ice, increasing the coverage of dark water. We used STELLA modelling software to create a model in which polar bear population is dependent on the melt of the Greenland ice sheet. Our model attempts to illustrate how increasing the rate of sea ice melt will affect polar bear population in the Davis Strait of Greenland. Other factors in polar bear population include birth rate and death rate. We expect that increased melting rates will set off the positive feedback loop, expediting the time it takes before there is no sea ice left, and therefore, no habitat for polar bears. Without a habitat, the polar population will decrease catastrophically.

75.

MODELING MALARIA: A STUDY OF THE SPREAD OF MALARIA DUE TO ANTHROPOGENICALLY INDUCED CLIMATE CHANGE USING STELLA MODELING SOFTWARE

Brooke Moore '15, Emily Hamilton '17
Faculty Sponsor: Jonathan Gourley

Anthropogenic carbon dioxide emissions have caused global temperatures to increase by approximately 0.8°C since the middle of the 20th century. IPCC climate models predict an additional 2°C rise in global temperatures by 2050 due to these emissions. This expected warming could cause massive reductions in biodiversity, severe increases in sea level and notable expansions in temperature-dependent diseases. This study attempted to quantify the temperature-induced spread of Malaria. Specifically, it sought to determine the human fatality

rate that would potentially ensue as a result of this parasitic expansion. We applied data regarding automobile carbon dioxide emissions per person in order to assess whether these population reductions would affect total atmospheric CO_2 concentrations. The resulting model produced a negative feedback loop between total global population, total automobile CO_2 emissions, total atmospheric CO_2 concentrations, global temperatures and Malaria range. Therefore, our model demonstrated that the climate change induced spread of temperature-dependent diseases could be countered by a decrease in anthropogenic CO_2 emissions due to a reduced global population.

76.

MODELING TODAY'S PHOSPHOROUS CYCLE USING STELLA: A STUDY OF HOW A VITAL RESOURCE IS BEING DEPLETED DUE TO INEFFICIENT ANTHROPOGENIC CONSUMPTION AND MANAGEMENT

Kevin Premto '17, Preston Kelly '16
Faculty Sponsor: Jonathan Gourley

In this STELLA model we will be building the global phosphorous cycle in order to show the impacts of human interactions in the environment, which have altered the natural cycle of phosphorous (P). There is a very limited supply of P attainable to humans that power natural and agricultural processes. However, excess influxes in this system induced by humans globally can impact human health and the environment dramatically. In an attempt to show these fluctuations in the P cycle we have created three different models using STELLA. These models will show how anthropogenic factors impact the cycle; first by portraying a steady state model before adding perturbations from human influences. The second model will show how the system under over use of fertilizers is used to meet our global demand for agriculture. This will effect the cycle after the inevitable runoff of excess P that soils cannot hold. This is detrimental to aquatic systems through eutrophication and P loss. The third model will show the effect of mismanagement of animal/human waste runoff. Ultimately, we will be trying to find a balance between human consumption of P in a way that can meet our demands in a sustainable way that is less detrimental to our global environment.

77.

STELLA MODELING: CORAL, CARBON, AND CLIMATE CHANGE

Cristina Pretto '16, Kyaw San Min '17
Faculty Sponsor: Jonathan Gourley

Coral reefs act as a carbon sink which help to keep a portion of carbon dioxide out of the atmosphere. Thus, understanding how a coral reef functions becomes increasingly important to environmentalist as the search for disposals of carbon grows more desperate. In an attempt to better understand how coral reefs work as a system, we have created two STELLA models which look into how the populations of coral and carbon in coral fluctuation.The first model is a simulation of a "one coral world" with two determining attributes (Carbon and Insolation). The various scenarios are created with different combinations of the attributes to simulate life and death for the coral colony. This model will help to understand how the population of coral changes in relation to the different attributes and disturbances simulated into the model, especially those related to carbon. The second model observes how carbon flows through the atmosphere, ocean, and coral. The second model will show how changes in the coral carbon sink,

affect the carbon cycle. A hydrological cycle model is also engaged in order to observe changing sea levels and their effects on coral populations as well as the global net flux of carbon between the ocean and the atmosphere. Through analysis of these models, the ability for coral reefs to act as a sustainable carbon sink will be tested and further, the impact of a world without coral will be explored.

78.
THE FEASIBILITY OF CARBON NEUTRALITY: MODELING COSTA RICA'S CARBON CYCLE
Gregory Reardon '15
Faculty Sponsor: Jonathan Gourley

Costa Rica is known for its lush rainforests, other diverse ecosystems, and high levels of biodiversity. Due to the various benefits of biodiversity and health ecosystems, both the government and citizens of the country have made maintaining them a national priority. Greenhouse gasses, like carbon dioxide and methane, have been shown to have a variety of impacts on biodiversity and ecosystem health. This, along with additional financial incentives, has resulted in the government imposing a goal of national carbon neutrality by the year 2021. Several policies have been put into place in order to make sure the country achieves this goal; however, initial studies on carbon levels in the nation have doubted the how realistic it is. In this project, I sought to create a systems model that represented the carbon cycle of Costa Rica. This model was created using the computer program STELLA. The purpose of the project was to both determine the current levels of carbon emission in the country, and to evaluate how reasonable the goal of carbon neutrality by 2021. Initial results suggest that Costa Rica is currently far from carbon neutral, and in fact is a relatively significant source of atmospheric carbon. Given current rates of carbon emission and sequestration, it seems very unlikely that Costa Rica's goal will be accomplished by 2021.

79.
WILDFIRE GROWTH AND SUPPRESSION: ANALYSIS OF THE GREAT CEDAR FIRE (SAN DIEGO 2003)
T.J. Sherman '17
Faculty Sponsors: Christoph Geiss, Jonathan Gourley

Fire suppression techniques in highly vulnerable wildfire areas, specifically southwestern California, have been subject to much research and development due to severe drought the state has experienced over the last five years. The Great Cedar Fire that occurred in San Diego from October 25th through November 3rd, 2003 destroyed more than 270,000 acres of land while utilizing at it's peak, over 4,000 firefighters, is one such wildfire that has been evaluated and criticized heavily in terms of the wildfire suppression methods utilized. Using the STELLA modeling system, we attempted to accurately model the progression of the Great Cedar Fire in order to investigate the impact firefighters had on the suppression of the wildfire at the time and potentially determine more effective procedures for future wildfires of similar magnitude. The model found the greatest period of growth of a wildfire was within the first 24 hours, therefore utilization of firefighters must be maximized within this period in order to diminish the fire's rapid growth and ultimately decrease the potential acreage burned. Our findings suggest,

utilization of the eventual maximum 4,275 Cedar Fire firefighters during the first 24 hours of growth would have decreased the destroyed area by almost 100,000 acres.

80.
ASSESSING TEMPORAL AND SPATIAL VEGETATION CHANGES USING NDVI ANALYSIS
Jenna Wilborne ‘15
Faculty Sponsor: Cameron Douglass

One of the best ways to understand vegetation changes is from the use and manipulation of satellite imagery data in ArcMap. We used two spatial analyses: NDVI (Normalized Difference Vegetation Indexes) and Zonal Statistics to understand vegetation changes within the Knox Preserve, Stonington, CT between 2004 and 2012. Our results showed an increase in vegetation densities within grasslands, wetlands, and forested areas at the site. Increased vegetation densities throughout our forested areas might be a key indicator that our site is becoming dominated by certain invasive (non-native) vine and shrub species that have outcompeted the native species for land and resources. Future studies can be done to determine the percentage of invasive vine species coverage in forested areas and its effects on the native bird species populations.

HEALTH FELLOWS

81.
SCREENING FOR INTIMATE PARTNER VIOLENCE (IPV) IN A PEDIATRIC SURGERY OUTPATIENT CLINIC
Ashira Anderson ‘16
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Brendan T. Campbell, MD, Connecticut Children’s Medical Center, Susan DiVietro PhD, Connecticut Children’s Medical Center Injury Prevention Center

Objectives: Studies have shown that at least 3 in 10 women in the U.S. will experience rape, physical violence, and/or stalking by a partner in their lifetime. All of these acts of violence are considered to be Intimate Partner Violence (IPV), which is a type of violence by a current or former partner or spouse that can occur between heterosexual or same-sex couples and does not require sexual intimacy. The purpose of this study is to evaluate whether a tablet-based approach to screen for Intimate Partner Violence (IPV) is feasible in a pediatric outpatient setting

Methods: A "Convenience sample" was recruited from March 11-April 22, 2015 to take a short, confidential questionnaire, using an iPad and the survey software Qualtrics. The study population is solo female caregivers that bring their children into to the pediatric surgery clinic at Connecticut Children’s Medical Center (CCMC) for care.

Results: During the brief study period, we were able to screen 40 participants. Of those 40 participants, none of them screened positive for IPV. The mean score of the HITS questions was a 4.60 out of 20, with a range of 5.0. The mean score of the HITS questions plus two additional questions was a 6.70 out of 30, with a range of 7.0. One of the biggest challenges to screening for IPV was having only one iPad. There would be several potential recruits waiting in the

clinical exam room who both fit the inclusion criteria, but having only one iPad meant that only one person could be screened at once.
Conclusion: This study demonstrates that using a tablet-based screening tool is feasible in the pediatric surgery clinic. Future studies should be directed towards screening a larger number of patients and to higher risk populations.

82.
COGNITIVE CONTROL AS A MECHANISM AND INTERVENTION TARGET IN EMOTIONAL DISORDERS
Tess Bloomquist '16
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Kathy Mallinson, Lauren Hallion PhD, Institute of Living, Gretchen Diefenbach PhD, institute of Living

There has been a growing interest in computerized cognitive training (CCT) as a cost-effective treatment method for psychiatric disorders. This interest stems from a large and expanding body of research linking impairments in cognitive function to different symptoms of psychiatric disorders. CCT aims to reduce symptoms by alleviating the cognitive deficits that are hypothesized to underlie those symptoms. However, CCT is not always effective.
The goal of this study is to identify targets for a more effective CCT and reduce intrusive thought on emotional disorders. To determine this target, we are investigating whether intrusive thought may come from deficits in proactive and/or reactive cognitive control, as well as how emotional distracters affect this control.

Participants were recruited from throughout the Institute of Living who experience one of three DSM-5 disorders characterized by intrusive thought (OCD; GAD, MDD) as well as healthy controls. Each subject participated in a cognitive control task, the AX-CPT, which is a well-established, widely used measure of *proactive* and *reactive* cognitive control conducted through E-Prime on the computer, as well as an emotional version of the task. We found that emotional distracters had a much larger impact on a participants compared to emotionally neutral distracters. Additionally, participants showed a better performance on proactive versus reactive control tasks.

With this knowledge, a further study with brain imaging will be conducted to determine a more specific target for CCT which will facilitate the making of a new and more effective CCT when it comes to treating emotional disorders.

83.
THE EFFECTS OF SURGICAL TECHNIQUE AND PERIOPERATIVE WOUND CARE ON PEDIATRIC NEUROSURGICAL WOUND FAILURES
James Cescon '16
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Wound healing is broadly concerning to surgical specialties, and is an aspect of surgical care that is highly modifiable through pre, mid, and post-operative characteristics. These might include, but are not limited to, age, weight, BMI, the type of surgery and incision made, pre-operative steroid use, pre-operative radiation therapy, previous surgeries through the same site, suture type

and dressing type. The study we performed was a retrospective analysis of Connecticut Children's Medical Center (CCMC) pediatric neurosurgery patients, in which the aforementioned characteristics were evaluated systematically in order to analyze factors potentially influencing wound failure; defined here as a cerebrospinal fluid leak and/or wound dehiscence requiring surgeon intervention or revision. This study represents a first stage in establishing the factors that may predispose pediatric neurosurgery patients to surgical wound failure, and serves to inform the many pre, mid, and post-operative decisions made in pediatric neurosurgery.

84.

EVALUATING THE EFFICACY OF USING WEIGHT AT 24 HOURS OF LIFE AS REFERENCE FOR CALCULATION OF PERCENTAGE WEIGHT LOSS IN BREASTFEEDING INFANTS DELIVERED BY C-SECTION

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Exclusive breastfeeding in the newborn nursery is recommended for its benefits to the health of the infants. It is common practice for pediatric and nursing staff to view a weight loss of $\geq 10\%$ of birth weight as evidence of dehydration and to initiate supplements. Evidence is growing that transplacental transfer of intravenous fluids, given to a mother during delivery, may inflate the infant's birth weight. Studies suggest that the 24-hour weight is a preferred reference for weight loss calculation after the diuresis of this excess fluid. In March, 2014, the Hartford Hospital newborn nursery implemented the routine use of the infant's 24-hour weight to as the reference for calculation of weight loss.

The aim of the study is to evaluate the effectiveness and safety of this clinical intervention on decreasing the supplementation rate.

We performed a retrospective chart review of healthy, term, appropriate for gestational age newborns, delivered by C-section to mothers who planned to breastfeed, in two study periods: 12 months pre- and 12 months post-intervention. Subjects were drawn from the Women's Health perinatal dataset after patients were discharged. Infants supplemented within first 24 hours of life or transferred to the NICU were excluded.

The results from the analysis of the first 3 months of data from each study period (n=89 pre-intervention, n=61 post-intervention) showed that the intervention has resulted in a significant decrease in the overall supplementation rate, especially among first-time mothers, and no significant difference ($p>0.1$) in maximum percentage weight loss or length of stay, and even a decrease ($p=0.03$) in maximum transcutaneous bilirubin level, compared to using the birth weight as reference. If a bigger sample size is confirm these findings, the study has the potential to change clinical practice in other maternity hospitals and assist newborn nurseries in meeting national goals for breastfeeding.

85.

INTERPROFESSIONAL EDUCTION: A PRACTITIONER'S PERSPECTIVE

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Healthcare students during their graduate education conventionally learn in environments isolated from other health professionals. Isolated learning fosters post-licensure ideologies that hinder professional collaboration by the promotion of stereotypes and professional isolation. Interprofessional education (IPE) occurs when members of more than one health or social care profession learn interactively together for the explicit purpose of improving interprofessional collaboration. The following competencies are established through an interprofessional education: development of one's own professional identity, ability to work in interprofessional teams, establishment of mutual respect between professionals, and development of scholarship. Focusing on the opinions of advanced practice registered nurses (APRNs), the perspectives of a single profession that shares training in common with both nursing and medicine, it may be possible to determine if IPE could help their profession and reveal their willingness to embrace IPE. This perspective was determined through an internet based survey with 20 subject responses; further interviewing of four individual APRNs provide supplementary information and opinions. The convenience sample indicated that APRNs believe they have a better understanding of and better respect for other professionals than the understanding and respect they receive. This indicates a need for IPE initiatives. Support for IPE came from subjects that, although work in interprofessional teams regularly, believe increased teamwork would positively influence their practice. Although these professionals do not experience conflict in general, a consensus believed that IPE learning would increase their respect for other workers. Lastly, the idea that IPE develops scholarship was supported. This convenience sample of APRNs served to present the areas in this profession likely improved through IPE and personal testimony further added to their perspective. Expanding this survey to include other professionals could further support the relevance of and necessity for IPE.

86.

HEIGHT VELOCITY IN CHILDREN WITH ADHD

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Studies have shown a decrease in height and height velocity correlated to ADHD medication in children. (Safer, Allen, & Barr 1972 and 1975, as well as Safer, 1973b, and 1975) The current study seeks to describe the nature of height velocity deficit in children with ADHD. Data was obtained via retrospective chart reviews on children who were admitted to the Primary Care Center at CCMC, and diagnosed with ADHD. Chart abstractions were used to obtain height velocity and medication, while parental questionnaires were used for demographic information. This information is used to analyze changes in height velocity with respect to medication type, sex, ethnicity, and length of time on medication. As hypothesized, deficit in height velocity was most severe within one year of medicine initiation. The significance of this study is to describe the aforementioned patterns in the Hispanic/Latino population, which has not been studied in depth. It further adds to the body of research that supports the view that stimulants have an effect on stimulant medication while contradicting studies which conclude no effect of stimulant

medication on height. Furthermore, results from this study may be used to more accurately anticipate the effects of stimulant medication on height for future primary care pediatric patients at CCMC.

87.
DECISIONAL CONFLICT FOR PARENTS CONSENTING TO NEWBORN CIRCUMCISION

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Newborn circumcision is one of the most common surgical procedures in the world. Parents provide informed consent to having their newborn boy circumcised sometime after delivery when the infant is medically stable and the procedure is executed prior to discharge. Parents may experience uncertainty or conflict concerning their decision. One study investigated decisional conflict involving 100 parents whose sons were undergoing elective hypospadias repair and identified decisional conflict in about 25% of the couples There have been no studies examining this possibility in newborn circumcision and in fact an editorial in the same journal issue stated: "A similar study should be undertaken for newborn circumcision as well as circumcision in older children, as the procedure is performed often in the U.S. and the results would be enlightening". Decisional conflict among parents consenting to have their babies circumcised has never been explored. If we find that it is present in some parents and determine that it is associated with certain factors such as age, ethnicity, etc. this will help us identify parents who would benefit from interventions aimed at minimizing difficulties encountered during the decision making process. Such decision aids have been utilized in adult medicine as a quality improvement initiative known as "shared decision making". This information may be helpful to other providers who perform elective procedures on children.

We obtained baseline information about parents' possible uncertainty regarding their decision to have their sons circumcised. The data was entered into an Excel sheet and examined.

The resulting information may assist us in decreasing their conflict by addressing their concerns via parent education materials as well as during the informed consent discussion.

88.
USING MOTION CAPTURE TECHNOLOGY AND JOINT TIME FREQUENCY ANALYSIS TO OBJECTIVELY ASSESS POST-CONCUSSION BALANCE

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Concussions are a common sports related injury and are categorized as a blow to the head, neck or face often resulting in a loss of postural control. Treatment and diagnosis are made even more difficult as there is no physical trauma to on the brain, and thus cannot be detected using traditional imaging technology.

The main concern of healthcare professionals is determining when a subject is asymptomatic and can safely return to play. Tests such as the Balance Error Scoring System (BESS) have been developed to assess post-concussive symptoms. However, the validity of these tests is often questioned due to their subjectivity and poor interrater reliability.

Elite Sports Medicine (ESM) at Connecticut Children's Medical Center has sought to establish an objective, quantitative means for assessing post-concussion balance. Through the use of motion capture technology, subtle deviations in a subjects' balance can be measured and then analyzed using joint-time frequency analysis (JTFA) to identify balance identify balance dysfunction

This study examined the tandem-stance, eyes closed BESS test for 12 adolescent concussion patients seen at ESM. Results indicated that the BESS was correlated to balance improvements in the anterior-posterior direction, but not associated with improvements in the medial-lateral plane. The motion analysis measured BESS successfully detected balance improvement over the course of the subjects' treatment. Furthermore, the results showed a significant relationship between improvements in balance and subject reaction time suggesting that reaction time and balance are closely related.

This prospective study sets the stage for further research into the utilization of motion analysis and JTFA in assessing post-concussion balance and hints at the potential to improve balance by improving reaction time.

89.

AN INVESTIGATION INTO THE POST-OPERATIVE RECOVERY PROCESS AFTER THIRD MOLAR EXTRACTION BETWEEN DOCTORS AT THE AVON ORAL AND MAXILLOFACIAL SURGERY LLP

Haley Peterson '15
Faculty Sponsors: Alison Draper, Maryanne McGuire, RN, MPH, Gary B. Toubman, DMD, Stuart E. Lieblich, DMD

Third molar extraction is one of the most common dentoalveolar surgeries, with about 5 million people a year undergoing the procedure. This is a billion dollar industry, which makes it a topic of hot debate with many publications on the subject. There are many post-operative risks associated with third molar extraction; thus, it is important to know the doctor you have chosen and his success rate with the surgery. The study performed was retrospective. All the data was gathered using the Avon Oral and Maxillofacial Surgery LLP online patient file database. It was then transposed into an excel spreadsheet for the process of data analysis. Early results show no significant difference between the post-operative recovery processes for the patients of all three doctors. Studies comparing the surgical success of doctors are not commonly found. This kind of research could open the door for more studies like this allowing for patients to better understand who will be performing these procedures.

90.

A DESCRIPTION OF THE VARIABILITY IN OPIOID USE AND PAIN SCORES IN A GROUP OF POST-SURGICAL ADOLESCENTS AT CONNECTICUT CHILDREN'S MEDICAL CENTER (CCMC)

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Background: Each year in the United States over six million pediatric patients have surgery, and over 80 percent report having moderate to severe post-surgical pain. Individual experiences' with post-surgical pain varies in severity and analgesic effectiveness.

Purpose: We propose that pain medications prescribed based on knowledge of patients' ability to metabolize analgesics will result in more effective post-surgical pain management and lessen patients' risks for adverse affects. The purpose of this preliminary study is to determine how best to analyze post-surgical pain and analgesic effectiveness for associations with genetic variants, for example variants in CYP2D6.

Methods: We obtained data from adolescents (n=46) undergoing spinal fusion (27) or Nuss procedure (18). The adolescents' post-surgical pain intensity scores (NRS scale 0-10) and opioid use (in milligrams/hour of morphine equivalents) recorded in twelve-hour increments were analyzed.

Results: Patients' pain scores and opioid use were analyzed to categorize patients as effective analgesia (pain scores and opioid analgesia use consistently lower than the mean) or ineffective analgesia (pain scores and opioid analgesia use consistently higher than the mean). A small subset of patients trended towards these categorizations.

Conclusion: This study illustrates variance in adolescents' post-surgical pain experiences after major elective surgical procedures. The next step is to determine if genetic variants in CYP2D6 are associated with these analgesic efficacy categories. Predictable associations would allow for more accurate pre-surgical patient counseling about post-surgical pain and more effective analgesic planning. This allows for a patient specific pain management protocol, which enhances the patient's overall experience with the surgery.

NEUROSCIENCE

91.

INDIVIDUALIZED COGNITIVE REHABILITATION FOR ADULTS WITH ACQUIRED BRAIN INJURY (ABI)

Emily Aiken '15
Faculty Sponsor: Sarah Raskin

Acquired Brain Injury (ABI) can result from internal factors (e.g. tumor) or external causes (e.g. trauma). Three case studies of Kosakoff's syndrome, meningioma, and traumatic brain injury (TBI), will be presented to illustrate the variety of cognitive deficits across different individuals with ABI. This study uses cognitive rehabilitation therapies to target individual cognitive symptoms. Results and discussion place emphasis on the use of prospective memory (PM)

training for treating Kosakoff's syndrome. The Memory for Intentions Screening Test (MIST) served as the assessment for PM analysis pre and post rehabilitation. The data from this study will be used as a model for a larger study analyzing the effectiveness of different cognitive rehabilitative therapies: PM training, attention process training (APT) and executive function training, in treating ABI that are individualized based on cognitive symptoms.

92.

THE RELATIONSHIP BETWEEN EXECUTIVE FUNCTIONS AND PROSPECTIVE MEMORY IN SURVIVORS OF ACQUIRED BRAIN INJURY

Alexis Benedetto '15
Faculty Sponsor: Sarah Raskin

This study investigated the relationship between executive function and prospective memory in a group of fifteen acquired brain injury (ABI) survivors. Differences in executive function and prospective memory were compared between an independent group of survivors and a group that required a full time aid or lived in a facility. Overall, nine independent and six dependent survivors were tested on a series of executive function tests including the Executive Function Performance Test (EFPT), the Stroop Color Word Inference Test and the Trail Making Test. Prospective memory measures included the Memory for Intentions Screening Test (MIST) and the Prospective Memory Diary. Results of this study suggest that survivors who are unable to live independently experience more executive function deficits that impact daily functioning. However, due to the difficulty with recruitment, the number of individuals would have to be expanded to further understand the relationship between executive function and prospective memory between the groups.

93.

EFFECTS OF KETOGENIC DIETS ON AUTISTIC SYMPTOMS OF FEMALE EL MICE

Subrina Bisnauth '15
Faculty Sponsor: David Ruskin

The ketogenic diet (KD) is a restricted carbohydrate, high fat and sufficient protein metabolic therapy that elevates ketones as an alternative fuel source, and that reduces seizures in persons with epilepsy which is often comorbid with autism. Autism is characterized by communication deficits, decreased sociability and repetitive behaviours. A restrictive KD reverses symptoms in the BTBR mouse model of autism but its severity is a factor in its clinical applicability. In a study with the EL mouse model of epilepsy and autism, sex-dependent effects were found where only females displayed the behavioural effects of the KD. In the current study, a strict and a milder KD were tested on female EL mice to compare their effects on behavior, blood chemistry and body weight. This study investigated if increased ketones and lowered blood glucose were necessary for behavioural improvement. In order to do so, female EL mice were fed either a standard rodent chow control diet, the restrictive KD or the moderate KD from five weeks of age. At eight weeks of age, behavioral testing, using the 3-chamber test which measures sociability and self-directed repetitive behaviour (grooming), were conducted in order to determine whether autistic symptoms were still present. In addition, the social transmission of food preference test which measures sociability as well was carried out. Weight, blood glucose and ketone levels were also measured. The diets had very similar behavioural effects on the

animals, increasing sociability and reducing repetitive behaviours. Interestingly, the moderate KD caused increased weight and did not lower blood glucose yet still improved autistic behaviours. This suggests that caloric restriction and lowered blood glucose may not be necessary for improved behaviours as had previously been thought. Also, a clinical strength KD may possibly be beneficial and should be further studied.

94.

EFFECT OF HYDROGEN PEROXIDE ON CELL VIABILITY IN SH-SY5Y: OPTIMIZING A PROTOCOL FOR LUTEOLIN EXPOSURE

Isabella T. Dahilig '18, Emory M' Payne '18
Faculty Sponsor: William H. Church

As a motor-system disorder, Parkinson's Disease is associated with an increase in the rate of neurodegeneration characterized by the loss of dopaminergic cells of the Basal Ganglia. Decreased serum levels of uric acid, a primary antioxidant for humans, correlate with increased incidence of Parkinson's Disease and more rapid progression of the disease. Recent *in vitro* and *in vivo* studies have shown that decreased uric acid levels enhance neuronal cell death. Our project was to investigate the impact of luteolin, a flavonoid characterized by C-5 and C-6 hydroxyl groups, on neuronal cell viability. Luteolin, competitively inhibits the enzyme xanthine oxidase, resulting in decreased uric acid. Treatment of cells with luteolin could potentially decrease cell viability due to loss of cellular anti-oxidant content. As a primary experiment, SH-SY5Y cells were exposed for 24 hours to 100uM, 200uM, 300uM, 400uM and 800uM concentrations of hydrogen peroxide and imaged to quantify cell death and generation of oxidative species. Methods function as a preparation for and simulation of future experiments with varying concentrations of luteolin. Multiple trials have proved unsuccessful, in that high degrees of apoptosis have been found in all trials, including the control (0 uM H_2O_2). Fluorescent imaging using two different staining methods revealed complete cell death. Investigations into proper sterilie cell culture technique are being undertaken to determine the cause of excessive cell death. Additionally the cells demonstrated pyknosis prior to H_2O_2 exposure. Potential causes of apoptosis involved are error in calculations for media, aggressive aspiration, and cell overgrowth. Once the methodology proves effective, exposing SH-SY5Y cells exposed to H_2O_2 could serve to model apoptotic instances in neurodegenerative diseases such as Parkinson's Disease for future experimentation.

95.

THE EFFECT OF VIEWING WILDLIFE IMAGES ON THE SYMPATHETIC ADRENAL-MEDULLARY STRESS RESPONSE SYSTEM IN MILITARY VETERANS WITH VARYING LEVELS OF PTSD

Nicole Evancha '15
Faculty Sponsor: Sarah Raskin

Exposure to the natural environments, especially green-space such as forests and rural areas, has been shown to facilitate a decrease in stress levels as measured by self-report anxiety assessments; physiological monitoring of heart rate and galvanic skin response and salivary levels of cortisol and alpha amylase. While many studies use direct environmental exposure, other studies have demonstrated that the act of viewing images of natural environments produce similar anxiety mitigating effects. The goal of this experiment was to examine the effect of

viewing wildlife images on the stress response of military veterans. Ten military veterans and ten civilian participants were shown wildlife images from a Compost Investigation study conducted by Scott Smedley, PhD. Acute stress response expressed by stimulation of the sympathetic adrenal medullary system (SAM) before and after image observation was assessed through saliva sample analysis for alpha-amylase concentration. A galvanic skin response measure monitored alterations in SAM activity illustrated by skin conductance potentials during the image viewing process. The measure was utilized to determine differences in stress response in relation to daytime and nighttime image content. Stress levels of participants were predicted to fluctuate between day and night images due to the use of infrared illumination within nighttime images which could be similar to the use of military night-vision technology. Physiological stress response results were compared to self-report anxiety measures, the State-Trait Anxiety Inventory and Post-Traumatic Stress Checklist and each of these responses were compared for day images versus night images. Saliva analysis results indicate no difference between SAM activity pre and post image exposure in both veterans and civilian participants. STAI-S assessment results mirror those of the saliva amylase analysis. A significant difference in SAM activity in response to night and day images was shown in veterans through GSR value analysis. The study results suggest that veteran participants did not experience a reduction in stress in response to viewing wildlife images.

96.

INVESTIGATION OF A TIMP-1 MODULATED GLIAL-DERIVED CELL DEATH INDUCING FACTOR

Francesca Marino ‘16, Thomas Naragon ‘17, Sheila Njau ‘17, Nathaniel Thiemann ‘17
Faculty Sponsor: William H. Church

Astrocytes are known to secrete various neurotropic & apoptotic factors, which impact differentiated and undifferentiated neuronal cells. TIMP-1 is a tissue inhibitor of metalloproteinases, which is produced in astrocytes and has also been shown to have neuroprotective effects. Various experiments were conducted using media collected from wild type astrocytes (WTGCM) or TIMP-1 knockout astrocytes (KOGCM) on undifferentiated and differentiated SH-SY5Y cells, a human neuroblastoma cell line. Treatment of undifferentiated cells with KOGCM showed a significant increase in cell death when compared to treatments with WTGCM. Our results suggest that in the absence of TIMP-1, astrocytes secrete a factor which effects only undifferentiated SH-SY5Y cells and is heat-labile. Furthermore, fractionation experiments indicate that this factor has a molecular weight less than 50kDa. These results suggest that TIMP-1 and this <50kDa cell death-inducing factor interact intracellularly. Future research aims to identify the nature of this protein factor.

97.

THE EFFECTS OF CAFFEINE ON SYNAPTIC EFFICACY IN THE HIPPOCAMPUS OF FREE MOVNG RODENTS

Jenna Park ‘16, Nicholas Bellas ‘16, Chloe Desjardins ‘18, Thomas Gitchell ‘18, Vy Phan ‘18
Faculty Sponsor: J. Harry Blaise

The Electrophysiology Laboratories at Trinity College currently uses the synapse from the perforant path to the dentate gyrus as a cellular model system to study the effects of exposure to a host of conditions. One of the most consumed stimulants in the world today is caffeine.

Caffeine has long been known to benefit neurological functions, such as alertness, attention and memory. Despite its popularity, studies on the effect of caffeine on synaptic efficacy are still lacking. Long-term potentiation (LTP) is a persistent change in a neuron that increases its receptivity to stimulation from other neurons. Caffeine may increase LTP by affecting several aspects of the neuron including, the adenosine receptors, phosphodiesterases, ryanodine receptor channels, and GABA receptors. In this study, free behaving rats were used to determine the effect of caffeine on learning and memory. It was hypothesized that rats exposed to caffeine would show greater LTP suggesting an improvement in these neurological functions. Experimental Sprague-Dawley rats were administered caffeine daily in their water (10 mg/kg). At ages 70-120 days, stereotaxic surgery was used to place stimulating bipolar, recording, and ground electrodes into proper locations. After five to seven days of recovery, an oscilloscope was used to measure the population spike amplitude (PSA) of LTP. At this moment, a larger sample size is necessary to determine the effects of caffeine on learning memory. However, if the hypothesis were to be correct, the results would have far reaching implications for everything from LTP enhancing drugs to molecular understanding of learning and memory.

98.

RELATIONSHIP BETWEEN ELECTROPHYSIOLOGICAL AND BEHAVIORAL MEASURES OF PROSPECTIVE MEMORY IN INDIVIDUALS WITH MILD AND SEVERE ACQUIRED BRAIN INJURY

Consuelo Pedro ‘15, Erin Aisenberg ‘16, Tessa Bloomquist ‘16, Meaghan Race ‘18
Faculty Sponsor: Sarah Raskin

Prospective memory (PM) involves the ability to form and realize intentions after a time delay (Einstein & McDaniel, 1990). This experiment aims to examine the relationship between clinical measures of PM and an event-related potential paradigm (West & Ross-Munroe, 2002). Electrophysiological data was collected while performing a computerized laboratory PM measure and was compared to a clinical measure, the Memory for Intentions Screening Test (MIST) (Raskin, Buckheit, & Sherrod, 2011) in healthy adults (HA), individuals with severe acquired brain injury (sABI) and mild acquired brain injury (mABI). Results revealed that individuals with sABI performed significantly worse than individuals with mABI and HA on all variables of the MIST. Results also showed reduced amplitudes in individuals with sABI, on ERPs that have been associated with intention formation and intention retrieval when compared to individuals with mABI and HA. In addition, total score on the MIST was related to variables associated with attention retrieval. Overall, these findings suggest that individuals with sABI have deficits in PM compared to individuals with mABI and HA and that the MIST may be a valid measure of underlying brain processes in PM.

99.

BASELINE TESTS FOR CONDITIONED PLACE PREFERENCE IN BTBR MICE

Hannah R. Reichert ‘18
Faculty Sponsors: David N. Ruskin, Susan A. Masino

Autism is a hereditary disorder that is characterized by social impairments; specifically, patients avoid interacting with others, perform repetitive actions, and show a lack of social motivation. Because BTBR mice exhibit similar behavior, they have served as animal models in recent experiments that studied conditioning and the ketogenic diet, which were both used to try to

improve autistic behavior. Before further procedures could be performed, preliminary tests had to be conducted to form a baseline. Using an altered three-room device that had different patterned walls and floors, both control and BTBR mice were tested to determine if they had any place preference prior to conditioning. The mice were placed inside the device and allowed to individually explore the rooms for ten minutes. The time that they spent in each room was then recorded. For both the control mice and the BTBR mice, there was one wall/floor combination in which the mice showed no place preference. This result indicated that the mice did not favor either side of the device and spent about the same time in each room. Now that a baseline has been established, future work will involve starting a new study on conditioned place preference and incorporating the ketogenic diet. Ultimately, the findings may be applied to humans to form a new treatment for autism.

100.

MTOR SIGNALING AND ENDOPLASMIC RETICULUM STRESS IN MIXED GLIAL CULTURES

William Schreiber-Stainthorp ‘15
Faculty Sponsor: Hebe Guardiola-Diaz

Oligodendrocytes (OLs) are the key myelinating cells of the central nervous system; the extraordinary protein and lipid synthesis that myelin production entails makes OLs especially prone to endoplasmic reticulum (ER) stress. In this experiment, we set out to investigate the dynamics of ER stress in mixed glial cultures, and how the consequences of that stress vary based on the activity of the anabolic PI3K/AKT/mTOR pathway. Previous experiments in isolated OL cultures demonstrated a negative correlation between AKT/mTOR signaling and oligodendrocyte cell count in the presence of ER stressors. Because ER stress leads to a buildup of improperly processed proteins, decreases in mTOR pathway activity are thought to prevent the cell from accumulating an even greater excess of misfolded polypeptides. We hypothesized that administration of rapamycin, an inhibitor of mTOR, would ameliorate the effects of ER stress by preventing protein buildup caused by mTOR pathway activity. To test this hypothesis, mixed cultures of OLs and astrocytes were isolated from neonatal rat brains and exposed to tunicamycin (TU), an inhibitor of n-linked glycosylation, to induce ER stress. TU was administered alone and after pre-treatment with rapamycin, to investigate how the effects of ER stress change when the activity of that pathway was limited. By assaying cell survival and protein expression, we were able to determine how ER stress, with and without mTOR inhibition, affected cell populations in mixed glial cultures. We observed that the percentage of the total cellular population that was OL-lineage did not decline during chronic stress, but did decline during acute stress. This suggests that astrocytes may be maximally protective of OL during chronic stress. Meanwhile, rapamycin administration did not prevent the loss of OL-lineage cells though it did increase the number of total cells, suggesting that rapamycin preferentially improved astrocyte prognosis at the expense of OL survival. While other experiments have investigated the effects of ER toxins on activity of the mTOR pathway, this experiment is more faithful to in vivo conditions because it incorporates meaningful astrocyte-oligodendrocyte interactions that would be absent in isolated cultures, and is therefore more useful for understanding how organismal OLs respond to ER stress.

101.
EFFECT OF THE KETOGENIC DIET ON BEHAVIORAL SYMPTOMS OF AUTISM IN THE POLY(IC) MOUSE MODEL
Sierra Slade '15
Faculty Sponsor: David N. Ruskin

Autism spectrum disorder (ASD) is a neurological disorder characterized by decreased sociability, deficits in communication, and restricted and repetitive behaviors. The ketogenic diet (KD), a high-fat, low-carbohydrate, and moderate-protein diet has been shown to improve these three behavioral symptoms in the BTBR mouse model of autism. Epidemiological observations have shown that maternal immune activation (MIA) during pregnancy increases the risk of autism in offspring. Based on these observations, the poly-(inosine:cytosine) (IC) mouse model was developed. Poly(IC) is a synthetic analog of double stranded RNA and acts as a viral mimic. It is injected into a pregnant dam, activating an immune response without causing an infection. The offspring of this protocol are the poly(IC) MIA mouse model. They have been shown to have the autistic symptoms of deficits in sociability and communication as well as increased repetitive behaviors. In this study, pregnant dams were injected with poly(IC) or the saline vehicle during the late first trimester. The offspring were separated into control and test groups. At 5 weeks of age, the test group was placed on a 6:1 fat:(carbohydrates + protein) KD while the control groups remained on standard chow. After three weeks on the diet, sociability, repetitive behavior, and communication were assessed. Our results showed that KD reversed increased self-grooming in poly(IC) mice. Autistic-like behavior was not seen in our poly(IC) mice for social contact, sociability, grooming during the 3-chamber test, or repetitive behavior in the marble-burying test. However, KD increased social contact in poly(IC) mice. It also increased sociability and decreased 3-chamber grooming in poly(IC) males. Data also showed that poly(IC) mice did not have a deficit in the social transmission of food preference task, a previously unused assessment of the poly(IC) mouse model. While our study did not succeed in replicating several autistic behaviors in the poly(IC) mouse model, KD had influence on behavior in multiple measures, increasing sociability and decreasing grooming. This suggests that KD may be an effective diet therapy for autism.

PHYSICS

102.
CREATION AND CHARACTERIZATION OF HIGH QUALITY VORTEX BEAMS
Prawesh Dahal '18, Akrit Mudvari '18
Faculty Sponsor: Brett Barwick

Electromagnetic waves possess linear and angular momentum, which may be spin or orbital in nature. We attempt to study the nature of light waves that carry orbital angular momentum (OAM) and form optical vortices. Such optical vortex beams, called Laguerre-Gaussian (LG), can be derived from fundamental Gaussian beams. When projected onto a screen, these beams form ring shapes with zero intensity at the center and high intensity at certain radii, and these shapes are determined by their azimuthal and radial number. Since the interference patterns of the LG beams are determined by their azimuthal mode, we are able to detect or analyze LG beams with different azimuthal numbers by studying their interference with various waves.

PSYCHOLOGY

103.
ASSESSMENT OF NOVEL AUDITORY REHABILIITATION TRAINING METHODS
Erin Barney ‘15
Faculty Sponsor: Elizabeth Casserly

Cochlear implants partially restore hearing, but vary greatly in the benefit they provide for their users, making auditory rehabilitation training necessary. This study examined the potential of multiple talkers and top-down processing to enhance the auditory perceptual learning typically seen with normal-hearing participants using cochlear implant simulations. Participants (N = 64) were exposed to one of four lab-based auditory training methods using meaningful sentence materials: control training without cochlear implant simulation, single-talker training, multi-talker training, or training with passages of semantically coherent sentences. In all cases, the experiment involved two pre-tests, one hour of training, and five post-tests to assess perceptual learning and cross-context generalization. Performance above the control was seen in all three experimental groups for sentence recognition in quiet. In addition, the multi-talker training method generalized to a context word recognition task, and the passage training method caused gains in a task involving sentence recognition in multi-talker babble. This indicates that exposure to multiple talkers and semantic cohesion can produce generalized perceptual learning previously unseen with typical single-talker lab training.

104.
SPEECH THROUGH A (SIMULATED) COCHLEAR IMPLANT: TRYING TO SPEAK MORE CLEARLY, OR SOMETHING ELSE?
Nicholas Celestin ‘16, Nijel Hill, ‘15
Faculty Sponsor: Elizabeth Casserly

Talkers hearing their speech through a real-time cochlear implant (CI) simulator alter how they speak in multiple ways, e.g. reducing speaking rate (slowing down) and constricting F1/F2 vowel space (making their vowels sound more similar to one another). We know these changes occur, but we currently do not know *why* speakers make these alterations. In this study, we test the possibility that speakers are trying to sound more intelligible through the CI simulation, using what they hear as corrective feedback. We explored this possibility by conducting a playback experiment in which 34 naïve listeners assessed the intelligibility of speech produced under conditions of normal versus CI-simulated feedback. Listeners completed both a two-alternative forced choice discrimination task (“Which recording is easier to understand?”) and an open-set word recognition task (“What word did you just hear?”). Contrary to the feedback theory hypothesis, listeners found speech that was produced under CI-simulation to be *more* difficult to understand, not less, in the discrimination task (significant effect of Feedback, $p < .05$), and they heard no difference in the recognition task ($p > .05$). Speakers are therefore not trying to sound “better;” the changes in their speech must be due to other factors, e.g. an increase in cognitive load occurring as a result of the CI simulation.

105.
WHAT MAKES LIFE MEANINGFUL? A STUDY OF URBAN YOUTH AND THE RELATIONSHIP BETWEEN PROSOCIAL TENDENCIES, CIVIC ENGAGEMENT, AND PURPOSE IN LIFE

Ian J. Douglas '15
Faculty Sponsor: David Reuman

While some suggest that humans are fundamentally driven towards ruthless or self-serving behaviors as a means of promoting their genetic characteristics throughout the larger population, others suggest that other-oriented behaviors emerge just as naturally. Despite the immediate advantages of acting selfishly, acting prosocially results in long-term health benefits (e.g., reducing mortality rates) while enhancing psychological functioning. Theorists have suggested that one psychological advantage is an augmented sense of purpose that a helper may identify in his or her life. This study examines the process by which urban, Hartford-residing, youth develop meaning in their lives and express prosocial behaviors throughout their communities. Participants originated in and around the Hartford urban area, and were recruited either through a community service organization in which they were participating, or through an organization from which they were receiving supportive services. Results showed that the participants who provided community service through their organizations were more civically engaged than those who had been the recipients of a social service organization. Furthermore, for highly civically engaged youth, a measure of prosocial tendencies correlated with a measure of identified purpose. Implications for future social service implementation are discussed.

106.
AUTONOMOUS SENSORY MERIDIAN RESPONSE: THE ROLE OF ASMR AS A THERAPEUTIC RELAXATION TECHNIQUE

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Faculty Sponsor: Randolph Lee

The purpose of the current study is to investigate the efficacy of Autonomous Sensory Meridian Response (ASMR-Research.org, 2013) video viewing as a treatment of stress and anxiety. ASMR is a relaxing tingling sensation that progresses through the head and spine as a result of various triggers. Such triggers include behaviors like whispering, scratching, and tapping. This little known phenomenon is experienced largely through videos on YouTube, which are believed to induce relaxation and reduce stress, anxiety, and insomnia (ASMR-Research.org, 2013). It is hypothesized that ASMR will produce a significant reduction in the discussed issues in a comparable fashion to the effects of Benson's Relaxation Response (Benson et al., 1975), particularly in females (Foret et al., 2012). Undergraduate students were assigned randomly to one of three experimental conditions: ASMR, BRR, and control. Control participants watched a regular-voiced video from the same video creators used in the experimental session. The participants engaged in one individual session with task duration of thirty minutes, in addition to the time allotted for survey completion. The Perceived Stress Scale (PSS-10), State-Trait Anxiety Inventory (STAI), and a self-constructed ASMR Questionnaire acted as measures of the dependent variable. It was found that participants in the ASMR condition experienced significantly more relaxation than the control group. It was also evidenced that ASMR is distinctive from typical relaxation, as certain participants who did not experience this tingling feeling still felt relaxed upon viewing. When Tingling was accounted for, it became apparent

that Trait Anxiety was lower in those control participants who experienced tingling; while the experience was unexpected, this implies that individuals who have a tendency toward experiencing ASMR also tend to pull the relaxing aspects from their experiences, such as generally relaxing voices. While stress and anxiety were not significantly reduced in the experimental condition, it is likely that significance could be attained with future research designs. It is hoped that this study will bring to light the potential therapeutic role of ASMR and inspire further research on the phenomenon.

107.

PREVENTING AND REDUCING NON-MEDICAL PRESCRIPTION STIMULANT USE: A GROUP MOTIVATIONAL ENHANCEMENT INTERVENTION

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College students are at increased risk for engaging in non-medical prescription stimulant use (NMPSU; Looby et al., 2014). Despite widespread NMPSU on college campuses, however, no research has examined the efficacy of group-based motivational enhancement intervention targeting NMPSU. Accordingly, we recruited 31 Trinity College students who reported a history of NMPSU, or who demonstrated two or more risk factors for NMPSU, with the intent to reduce use (or initiation of use), positive expectations of NMPSU, and study self-efficacy. Students were randomized into one of two conditions: (1) a group-based motivational enhancement intervention, which involved discussing NMPSU, study strategies, and pros/cons of NMPSU, or (2) a control group. We found limited support for our hypotheses; that is, NMPS users in the intervention group did not report a reduction in use compared to NMPS users in the control group, nor did they report a greater readiness to change behavior. As hypothesized, we found a trend for positive expectancies to decline in the treatment group, but no significant change in negative expectancies. Contrary to the last hypothesis, study self-efficacy didn't improve for the treatment group. Implications for future interventions targeting NMPSU are discussed.

108.

ENHANCING METACOGNITION AND MINDFULNESS IN MIDDLE SCHOOL STUDENTS: CAN SIMULTANEOUS INTERVENTIONS IMPROVE ACADEMIC PERFORMANCE?

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Faculty Sponsors: Dina Anselmi, David Reuman, Ms. Debra Avery (HMTCA)

Research on metacognition has shown a strong link between students' metacognitive abilities and their subsequent academic performance, yet most teachers do not provide explicit metacognitive instruction in the classroom. Similarly, literature on mindfulness suggests that mindful practice can improve students' self-regulatory skills and executive functioning, yet mindfulness is rarely incorporated into school curricula. In this study, we assessed the effectiveness of simultaneous interventions related to these two components. An eight-week metacognitive intervention was designed based on the Ambrose et al. model of metacognition in order to foster students' use of metacognitive skills. In addition, an eight-week mindfulness curriculum was developed to cultivate students' present-moment awareness. Five eighth-grade social studies sections (N=103) taught by one teacher participated in the study. Two sections were randomly assigned to the Metacognitive Intervention, one section to the Mindfulness

Intervention, one section to the combined Metacognition and Mindfulness Intervention, and one section served as the control group. Using pre- and post-testing quantitative and qualitative measures, we assessed the students' levels of metacognition and mindfulness, as well as any grade improvements from the first to third marking period. Contrary to our predictions, there was no effect of the metacognitive or mindfulness interventions on quantitative measures; the interventions however, did have an effect for both metacognitive and mindfulness qualitative measures. Measures of metacognition, but not mindfulness, were positively correlated with course grades. The metacognition and mindfulness interventions did not influence course grades as predicted.

109.
A LONGITUDINAL EXAMINATION OF PARENTAL AND PEER ATTACHMENT AND ITS ASSOCIATION WITH COLLEGE ADJUSTMENT AND RISKY BEHAVIOR DURING THE COLLEGE YEARS

Michelle Long '15
Faculty Sponsor: Laura Holt

Numerous studies have shown that among college students, a secure attachment to parents and peers is related to higher social and emotional competence and decreased likelihood of engaging in risky behavior (Laible, 2007; Mattanah et al., 2011). Far fewer studies, however, have examined parental and peer attachment longitudinally and how it relates to students' well-being. This study followed up with 222 students who participated in a study three years ago examining attachment and college adjustment during the first semester at Trinity. Over two-thirds (70%) of students responded to the online senior survey (64% female) assessing current parent and peer attachment, social adjustment to college, emotional well-being, social competence, substance use, motives for engaging in sexual behavior, and risky sexual practices. Several study hypotheses were supported; specifically, parent and peer attachment were stable over three years; participants reporting high parent and high peer attachment evidenced the best social and personal/emotional adjustment senior year and healthier motives for engaging in sexual motives; students who transitioned from a less to more secure attachment style functioned similarly to people who reported consistently high parent and peer attachment. Attachment security was not a consistent predictor of substance use and risky sexual behavior. Findings suggest that attachment to parents and peers continues to predict college adjustment and motives for sexual behavior through senior year.

110.
PARTICIPATION IN A GROUP OF FORMERLY INCARCERATED WOMEN ON STUDENTS SELF ESTEEM, EMPATHY, SELF DISCLOSURE AND ANXIETY

Nicole Lukac '15
Faculty Sponsors: Randolph Lee, Judy Dworin

Many people anecdotally report positive personal effects as a result of participating in social service projects. Few programs, if any, in the country exist that bring together formerly incarcerated women and college students to engage in multi-arts activities that are designed to be interactive and build relationship, self confidence and self-expression for both the women and the college students involved. The purpose of this study was to examine whether semester-long participation in a group that works to help reintegrate formerly incarcerated women, called New

Beginnings, affects levels of empathy, self-disclosure, self-esteem and anxiety. 12 students involved in the program were given established instruments to measure these characteristics before beginning the program, as were 12 control participants. It was hypothesized that students who participate in this group would demonstrate higher empathy, self-esteem, self-disclosure and lower anxiety at the end of the program compared to controls. Results from the study found no significant interactions for empathy, self disclosure, anxiety or self esteem and a main effect for time for State and Trait Anxiety. Implications for future research and suggestions for improving similar programs are suggested.

111.
THE EFFECT OF RELATIONSHIP EDUCATION ON COLLEGE STUDENTS' NEGATIVE AFFECT, RELATIONSHIP BELIEFS, AND RISKY SEXUAL BEHAVIOR
Katherine Rorer '15
Faculty Sponsor: Laura Holt

The college years are a key time to enhance students' relationship skills, since most students have had experience in romantic relationships, but are not yet in a marital relationship. Research suggests that the quality of students' romantic relationships is associated with their psychological and physical functioning; however, few studies have examined whether interventions can improve students' relationship competencies and, in turn, enhance their well-being. I worked with collaborators at Towson University to compare the effects of a (1) five hour group-based relationship education intervention with (2) a self-administered online intervention, and (3) a control condition, which did not receive any relationship skills training. The two active interventions worked to enhance students' awareness about picking partners, helped students to develop successful communication and conflict resolution skills, and challenged students' maladaptive relationship beliefs. I hypothesized that, compared to a control group, students receiving the group or online intervention would show decreases in depression, stress, anxiety, risky sexual behavior, and the number of maladaptive relationship beliefs endorsed. Overall, my intervention did not yield results in concordance with my hypotheses. Contrary to my first hypothesis, neither the group intervention nor ePREP showed significant declines in depression, anxiety, or stress over the course of a month. Contrary to the second hypothesis, participation in the group intervention and ePREP intervention did not lead to a significant decline in risky sexual behavior. There was marginal support for the third hypothesis that relationship education could change relationship beliefs; that is, students receiving the intervention were less likely to perceive disagreement as negative following the intervention. Given that nearly half the sample was not actively in a relationship, it might be useful to modify the intervention content so that it is applicable to a wider range of relationships, such as parent and peer relationships.

112.
THE RELATIONSHIP BETWEEN ACADEMIC AND PSYCHOLOGICAL HELP SEEKING AND ATTACHMENT STYLES
Julia Sager '15
Faculty Sponsor: Dina Anselmi

Research has shown a relationship between an individual's attachment style and help seeking behaviors. However, most studies have focused either on academic or psychological help seeking separately. The goal of my study was to see if, for Trinity College students, there were

differences in the types of help seeking behaviors depending on one's attachment style. I predicted that students with a secure attachment would report willingness to seek help in both academic and psychological settings when necessary. Students with an avoidant attachment would report a strong resistance to seeking both psychological and academic help. Students with an anxious/ambivalent attachment would report inconsistent willingness to seek help. Lastly, I predicted that female participants would report greater willingness to seek both academic and psychological help than male participants. To measure attachment style I used the Adult Attachment Scale (Collins and Read, 1990). To measure students' propensity for seeking psychological help I used the Attitudes Toward Seeking Professional Psychological Help Scale-Short Form (Fischer & Farina 1995). To measure students' willingness to seek academic help I used Karabenick's Help-Seeking Scale (2003). No significant relationship was found between students' attachment styles and their willingness to seek psychological help, but there do appear to be some differences in attachment styles' influence on academic help seeking. There also appears to be a relationship between gender and willingness to seek academic help.

113.

EXTENDED STEREOTYPE THREAT: PARENTAL CONCERN THAT A CHILD WILL CONFIRM A NEGTIVE STEREOTYPE ASSOCIATED WITH DYSLEXIA

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Faculty Sponsors: David Reuman, Elizabeth Casserly

This study introduces a novel concept Extended Stereotype Threat (EST). EST is based on stereotype threat, whereby one is concerned that he/she may confirm a negative stereotype associated with being a member of a targeted group. EST extends stereotype threat as someone outside a targeted group (e.g., a parent of a dyslexic child) fears that a member of that group (i.e., his/her child) will confirm a negative stereotype associated with the group. Seventeen parents of dyslexic children between the 3rd and 8th grades were interviewed. Topics included beliefs about dyslexia, interactions with the child's school, and how parents' beliefs about dyslexia influenced interactions with their child. While 13 of the 17 parents experienced EST, the ways they interacted with their child and school personnel varied. Once children were determined to be dyslexic, EST parents became more emotionally accommodating, more pragmatic in providing support, or made no changes in their interactions with their child.