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THIRTIETH ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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BIOLOGY

1.
USE OF SCANNING ELECTRON MICROSCOPY TO EXAMINE BIOLOGICAL SPECIMENS
Madeline Barnes '20, Luisa Lestz '19
Faculty Sponsor: Daniel G. Blackburn

Scanning electron microcopy (SEM) is an important tool in examining biological structure. This semester we have devoted our research to the preparation of samples for SEM examination and how to use Trinity College's SEM facility. This has allowed us to examine the surface of samples on a microscopic level. Scanning electron microscopy uses a concentrated beam of electrons, forming interactions between the electrons and the atoms from the sample, to produce the signals that form an image. The electrons are produced through a tungsten-hairpin filament gun and thermionic emission produces the electrons at the tip of the filament. To prepare a sample for SEM, the yolk tissue was dehydrated using a critical point dryer and subsequently coated in gold palladium. Sputter coating forms a conductive coating around the tissue sample to prevent a negative charge build-up from the electron beam. To obtain an optimal image, certain variables were controlled such as working distance, the strength of interactions between the electron beam and the specimen, and the depth of field. We have examined biological specimens ranging from beetle wings, fish tails, plant tissue, and turtle eggs all of which required specific settings such as a larger working distance for more delicate samples and manipulation of the contrast and brightness, depending on the focus of the photograph. In the future, these techniques can be used for examining the egg yolk of corn snakes and turtles containing endodermal cells.

2.
THE EFFECT OF NACL CONCENTRATION ON THE GROWTH RATE OF A STRAIN OF *NAVICULA IN VITRO*
Zach Battipaglia '17, Elias Peterson '19
Faculty Sponsor: Craig W. Schneider

Salt is omnipresent in aquatic ecosystems in at least some form, yet a rapid influx of salt resulting in significant changes in salinity can be devastating to organisms accustomed to low concentrations of salt. This can occur through anthropogenic means such as salt runoff from roadways into nearby freshwater bodies or naturally by salt spray to nearby lakes or streams. Previous studies have found that cell growth and reproduction of certain freshwater algal species are significantly affected by salinity levels above approximately 10 psu. It is also true that certain freshwater species can tolerate higher levels of salinity. Past literature on *Navicula cincta* shows that the species is extremely euryhaline compared to other freshwater diatoms. In this study, the effects of different concentrations of NaCl, ranging from 0-35 psu, were tested on a strain of the freshwater diatom genus *Navicula.* Diatom growth in Bold's Basal medium was recorded over a six da period by measuring chlorophyll B using a portable fluorometer. All salinities tested, including the control, followed a similar growth profile *in vitro* for this particular strain of *Navicula*.

3.
REMOVAL OF A 65 AMINO ACID REGION OF THE SERRATE JUXTAMEMBRANE SEGMENT AND ITS EFFECTS ON NOTCH ACTIVATION
Scott J. Buchanan '17
Faculty Sponsor: Robert Fleming

In *Drosophila melanogaster*, the Notch Signaling Pathway is crucial to the development of the organism. It helps regulate cell fate during development and maintains cell upkeep in mature organisms. The pathway operates via the interactions of a ligand and a receptor. In *Drosophila*, the receptor is called Notch, and the ligands are called Serrate and Delta. The ligand Serrate is the focus of my research. The extra-membrane region of Serrate consists of: a DSL (delta, serrate and lag) domain, 14 epidermal growth factor-like repeats(ELR's), a juxtamembrane region (JM; the region right next to the membrane), a transmembrane region, and an intracellular domain. It has been previously established that the removal of the JM region eliminates the capability of a Serrate-expressing cell to activate Notch. However, the ligand will still retain its intrinsic ability to inhibit Notch receptor function. Restoring 65 amino acids of the juxtamembrane region has been shown to restore activating capabilities to the ligand. The focus of my recent research has been to replace this 65-amino acid region with the corresponding regions of several other ligands to test their effects on the activation ability of Serrate. No other ligand's JM region has been able to restore activation capability completely. Thus, there must be something important in the 65 amino acids of Serrate's JM region. Until now, the constructs I have created were made in an artificial Serrate minigene form that is dramatically reduced in the ELR region of the molecule. My latest project was to simply create a construct where I removed the 65-amino acid portion of Serrate from the wild type form, to ensure that the results we were seeing were not the result of artificial interactions that would not actually be present in wild type. It is anticipated that the loss of this region from wild type will destroy the activating capabilities of the ligand.

4.
EFFECTS OF ESTRADIOL ON RADIAL GLIAL FIBER DENSITY THE WEAKLY ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS*
Jessica Chotiner '17
Faculty Sponsor: Kent Dunlap

Radial glia serve as neural stem cells and make migratory pathways in the vertebrate nervous system. Moreover, they are regulated by steroids and social stimulation. Radial glia express estrogen receptors and aromatase, indicating they are both a target and source of estrogen. This study examines the effects of exogenous estradiol on the radial glial fiber density in two brain regions of the weakly electric fish, *Apteronotus leptorhynchus.* I administered estradiol via implants in the peritoneal cavity and compared estradiol implanted fish to sham implanted and intact fish. I used immunohistochemistry to label for the radial glial marker vimentin and quantified the radial glial fiber density in the dorsal lateral and dorsal medial telencephalon, as well as the periventricular zone of the diencephalon. I found no effect of estrogen administration on vimentin immunoreactivity (VIR). Additionally, males and females did not differ in VIR, indicating that endogenous estrogen does not influence radial glia proliferation as well. Within individuals, immunoreactivity scores were positively correlated between the telencephalon regions, but telencephalic VIR did not correlate significantly with labeling in the diencephalon. This evidence suggests that radial glia are regulated independently across major brain regions.

5,
BUILDING A SEGMENTED BODY: THE CELL DYNAMICS OF POSTERIOR ELONGATION
Nicole Duan '18
Faculty Sponsor: Terri Williams

Segmentation is a key feature of arthropod diversity. Most arthropods add segments during development from a posterior region called "the growth zone", which is the site of elongation and segment patterning. While segment patterning is being studied in diverse taxa, the cell behaviors underlying elongation are less well known. We are studying segmentation in a crustacean, *Thamnocephalus platyurus* that adds segments after hatching. Since *T. platyurus* larvae have a cuticle restricting cell migration during segmentation, cell proliferation is commonly believed to be the dominant mechanism of elongation. The default model of the growth zone is that there is a constant motor of undifferentiated cells dividing to provide the tissue required for new segments. We tested this model by examining cell division patterns in the posterior growth zone, and our findings do not support this model of growth zone elongation. By looking at cells undergoing either S phase or M phase, we found that the rate of mitosis was surprisingly low. We found that DNA synthesis was spatially organized and temporally constant throughout segment addition. There are distinct anterior and posterior domains of cell cycling in growth zone cells that include an apparent synchronization of cell cycle in anterior cells and an arrested or slower S-phase in posterior cells. Contradicting the traditional belief of growth zone behavior that a high rate of mitosis occurs in the growth zone before segment specification, we observed that a high rate of mitosis occurs after segment specification, outside the growth zone, and we estimated that growth zone cells need to proliferate only 1.5 times to generate all added segments. The random low mitosis seen in the posterior serves to maintain the growth zone. One method of cell cycle regulation in the growth zone might be Wnt signaling, since distinct Wnts are expressed in the distinct cell cycle domains and pharmacological knockdown of Wnt disrupts cell orientation and morphology in the growth zone.

6.
COULD A CARDENOLIDE OR ITS PRECURSER LEAD TO THE SYNTHESIS OF LUCIBUFAGINS, DEFENSIVE CHEMICALS, IN *PHOTURIS* FIREFLIES?
Maddie Farrar '19, Latanya Coke '19
Faculty Sponsor: Scott Smedley

Lucibufagins (LBGs) are defensive chemicals found in fireflies. *Photuris* fireflies release their LBGs through a series of pores in a process called reflex bleeding. Although *Photuris* females contain LBGs, they do not synthesize them directly but acquire them through their 'femme fatale' behavior in which they prey upon LBG-producing fireflies. *Photuris* males captured in the field are found with varying low levels of LBGs of unknown origin, but plants are a potential source. The milkweed plant (*Aesclepias syriaca*) is protected from herbivories with chemicals called cardenolides. Cardenolides and LBGs share a steroidal core, but cardenolides contain a lactone ring, while LBGs contain a pyrone ring. Cardenolides appear difficult to convert directly into LBGs, but a precursor molecule to cardenolide could be utilized to synthesize LBGs. Reared *Photuris* were randomly assigned to treatment blocks consisting of control, ouabain (a cardenolide) and pregnenolone (a precursor compound to cardenolides). A 10% honey water solution, mimicking nectar, was laced with these chemicals. In each case, aliquots of 100 µl of a 100 µmol solution was placed daily for four days in small wells mimicking floral nectaries. On the fifth day,

the *Photuris* rested before being sampled (whole body) on the sixth day. SEM imaging was used to visualize the cuticular pores through which the LBG-containing hemolymph is released during reflex bleeding. We are awaiting the results of the chemical analysis, but hypothesize that the pregnenolone treatment may be more likely, compared to the ouabain treatment, to be converted to LBGs based on chemical structure. Future research is necessary to learn about the mechanisms required to convert precursor compounds into LBGs.

7.
FETAL MEMBRANE MORPHOLOGY IN OVIPAROUS LAMPROPELTINE SNAKES (COLUBRIDAE)
Young K. Kim '17
Faculty Sponsor: Daniel G. Blackburn

In oviparous reptiles, fetal membranes line the eggshell and maintain the developing embryo by regulating gas exchange and the uptake of water and calcium. Unfortunately, the scarcity of morphological studies hinders an understanding of their functional specializations and evolution. We have used scanning electron microscopy to study fetal membrane morphology in two oviparous snakes, the Pueblan milksnake, *Lampropeltis triangulum campbelli*, and the kingsnake, *Lampropeltis getula*. In both species, two major fetal membranes, the chorioallantois and yolk sac omphalopleure, are present. The chorioallantois in early development is characterized by enlarged chorionic and allantoic epithelia and avascular connective tissue. As the chorioallantois matures, vascularization increases and the chorionic epithelium thins to facilitate gas exchange. The yolk sac omphalopleure is initially an avascular structure which is transformed into an omphalallantois upon vascularization by the allantoic capillaries. As the isolated yolk mass regresses and the epithelia thin, the omphalallantois is transformed into a chorioallantois, enhancing the growing embryo's potential for gas exchange. In early development, the chorionic epithelium exhibits microvilli that increase surface area for water uptake. The allantoic epithelial cells may produce allantois fluid involved in water uptake and storage. Our findings are consistent with a previous study on the corn snake, *Pantherophis guttatus*, but offer novel morphological observations and functional hypothesis. Comparisons of fetal membranes to those of other squamate species may contribute to a reconstruction of ancestral characteristics for snakes.

8.
SOCIAL INTERACTION MITIGATES THE DELETERIOUS EFFECTS OF PREDATOR STRESS ON BRAIN CELL PROLIFERATION IN WEAKLY ELECTRIC FISH *APTERONOTUS LEPTORYNCHUS*
Elise Lasky '17
Faculty Sponsor: Kent Dunlap

It is already known that social isolation and predator stress can adversely influence neurogenesis in the weakly electric fish, *Apteronotus leptorhynchus*. Social interaction has also been shown increase brain cell proliferation in the fish. By using three different treatment groups 1) two non-chased fish paired together 2) a non-chased fish paired with a chased fish and 3) an isolated chased fish, the effect of social interaction and predator stimuli was investigated. The brain cell proliferation was then measured for groups of fish 1) a non-chased fish paired with a non-chased fish 2) a non-chased fish paired with a chased fish 3) a chased fish paired with a non-chased fish and 4) an isolated chased fish. When comparing all three types of fish within the paired treatment

groups there were no differences in forebrain cell proliferation. A significant decrease in brain cell proliferation was seen in the isolated chased fish when compared to all three types of fish in the paired treatment. This data suggests that social interaction mitigates the adverse effect of predation on brain cell proliferation.

9.
THE EFFECT OF SALINITY ON THE GROWTH OF MARINE CYANOBACTERIUM
SPIRULINA
Luisa Lestz '19, Yunzhuo (Doris) Zhang '19
Faculty Sponsor: Craig W. Schneider

In a constantly fluctuating environment, ecological generalists have an important advantage over other competing organisms. Species have a certain level of tolerance for different factors such as light, temperature, and salinity. In this experiment, we explored the effect of salinity on a marine cyanobacterium in order to determine how well the organism tolerated high salt concentrations. The marine blue-green *Spirulina* was placed in seawater solutions with varying concentrations of salt and allowed to grow in 20°C incubator (16L:8D). Over the course of 12 da, the chlorophyll a concentration (mg/L) in each tube was measured using a fluorometer every three da as a measure of *Spirulina* cell growth. Results showed that *Spirulina* populations were the greatest in the highest salt concentrations. Certain species of Spirulina are popular as a health food because they are high in protein and nutrients. The blue-green's adaptability to a range of salinity concentrations suggests that this organism could be a valuable and sustainable crop in the future. Further studies should focus on other limiting factors for *Spirulina* that affect plant growth.

10.
MOLECULAR-ASSISTED ALPHA TAXONOMY (MAAT) OF THE RED ALGAL GENUS *SPYRIDIA* (SPYRIDIACEAE, RHODOPHYTA) IN BERMUDA
Luke Maynard '17
Faculty Sponsor: Craig W. Schneider

Spyridia is a pantropical red algal species that is also found in warm temperate waters such as the Mediterranean Sea, the southeastern US and Bermuda, and also cold temperate environments such as New England, California and Japan. The genus includes cryptic (morphologically indistinguishable) species, and recent taxonomic studies have used modern DNA barcoding techniques to differentiate between what have classically been considered conspecifics. Such information is invaluable to increasing our knowledge of phenotypic variation and geographical distribution of algal genera. Molecular-assisted alpha taxonomy begins with the generation of a phylogenetic tree, in this case constructed from COI-5' gene sequences of *Spyridia* samples collected along the Bermuda coast. This demonstrated a need to subdivide the two *Spyridia* members historically reported in the islands, and then to differentiate the revealed pseudocryptic species by gross morphology and microscopic anatomy in order to create a field reference for distinguishing each of the Bermuda species. At this time, COI-5' sequencing has revealed seven genetic species, and subsequent observations have in most cases revealed characters that can be used to morphologically identify future collected species.

11.
THE EFFECTS OF TRICLOSAN ON THE FRESHWATER XANTHOPHYTE
ELLIPSOIDION
Kyle McCarthy '18, Lucy Pereira '20
Faculty Sponsor: Craig W. Schneider

Triclosan is an industrial antimicrobial compound found in a variety of everyday objects, ranging from children's toys to toothpaste, and present in 75% of all soaps sold in the United States. According to a U.S. Geological Survey study of 95 different organic wastewater contaminants, triclosan was one of the most frequently detected compounds and was found at high concentrations. Previous studies looking at the effects of triclosan on microalgae and bacteria, found that the presence of triclosan caused an increase in bacterial mortality and reduced algae viability. Our experiment looked at the effects of six different concentrations of triclosan (0, 5, 25, 125, 250 and 500 μg/L) on a freshwater xanthophyte *Ellipsoidion*. Cultures were kept in an incubator at 20˚C with a light cycle of 16 hr light and 8 hr of dark. *In vitro* cell density in cultures tubes was measured to indicate the effects of triclosan in the aquatic environment. Results indicated that there was little change in the cell density of treatment levels of 5 and 50 μg/L. At higher concentrations of 125, 250 and 500 μg/L significant reduction in cell density was found. This shows that greater concentrations of triclosan have a profound effect in reducing the cell density of *Ellipsoidion.*

12.
AN EXPLORATION OF THE GUT BACTERIA IN A MOUSE MODEL OF AUTISM SPECTRUM DISORDER ON A KETOGENIC DIET
Laura Nee '17
Faculty Sponsor: Lisa-Anne Foster

Alterations in the gut bacteria presence and abundance have been noted in certain diseased states like autism spectrum disorder (ASD). The BTBR T+tf/J mouse strain exhibits the three core behavioral symptoms of ASD and is thus used as the model organism to study ASD in this study. Previous studies have shown that a high-fat, ketogenic diet significantly improves all three core symptoms of ASD. The aim of this study was to catalog differences between the gut bacteria of healthy mice on standard and ketogenic diets as well as BTBR mice on standard and ketogenic diets. In particular, an unidentified species was found to be significantly present only in the healthy mice, another species was found only in the BTBR/standard diet group, and another only in the BTBR/ketogenic diet group. The identities of these three bacteria were unable to be classified due to error in DNA sample preparation and time constraints. A protocol was created to check the identities of these three species using PCR and gel electrophoresis. PCR primers were created for 10 bacterial species based on Finegold et al.'s work with the gut bacteria in autistic individuals. In the future, the polymerase chain reactions should be conducted on the original DNA samples based on which groups they were present in in each study and the sequencing defect should be worked out in order to classify the three species of interest in a more direct manner.

13.
DETERMINING SEASONAL TIMING OF INFECTION OF THE WINTER FIREFLY (*ELLYCHNIA CORRUSCA*) BY A PARASITOID FLY (*APOCEPHALUS ANTENNATUS*): A MOLECULAR GENETIC AND BEHAVIORAL ANALYSIS
Julia Pitino '18
Faculty Sponsor: Scott Smedley

Ellychnia corrusca, an eastern North American firefly species, overwinters as an adult. Locally, *E. corrusca* adults appear in September/October, spend the winter exposed on tree trunks, then die soon after reproducing in the spring. We have found that local populations of this firefly are hosts to a parasitoid fly, the phorid *Apocephalus antennatus,* which develops inside the firefly host, consuming its internal organs and eventually killing it. One key question in understanding this ecological interaction is the timing of infection. *A. antennatus* typically emerges as a fully developed larva from its host in the spring. Do these emergent flies result from infection during the previous fall (and subsequent dormancy) or during the current spring? *E. corrusca* were collected in the early winter and spring to assess the timing of infection. Samples were separated into groups for the following analyses: detection of *A. antennatus* DNA within the firefly using PCR with phorid-specific primers, and a longitudinal survey of parasitoid emergence/firefly viability. The survey data from the early winter samples show no phorid emergence. Future directions of both the molecular and behavioral components of this project include completing the analysis of the early winter and spring samples. Establishing when *A. antennatus* infects is important to understand the unusual seasonality of *E. corrusca*. It has been suggested that the firefly's winter exposure could potentially function to minimize the impact of the parasitoid. This hypothesis clearly hinges upon fall infection by the parasitoid.

14.
THE MECHANISM BY WHICH YOLK IS PROCESSED FOR EMBRYONIC DEVELOPMENT IN SQUAMATE REPTILES
Kathryn Powers '17
Faculty Sponsors: Daniel G. Blackburn, Yunming Hu, EM Facility Lab Manager

Unlike birds, which employ a well-vascularized yolk sac to transport nutrients to the embryo, corn snakes (*Pantherophis guttatus*), kingsnakes (*Lampropeltis getula*), and Pueblan milksnakes (*L. triangulum campbelli*) use an elaborate network of blood vessels that penetrate directly into the yolk mass. In this study, we have used stereomicroscopy, light microscopy, and scanning electron microcopy to image yolk samples from eggs of early to late developmental stages. Our observations have revealed how the large yolk mass is cellularized, vascularized, and mobilized for embryonic use. As the endodermal cells proliferate, they form a meshwork of interconnected cells that are filled with liquid yolk spheres. During angiogenesis, the vitelline blood vessels become encased in these cells, allowing them to transport the products of yolk digestion back to the developing embryo. Preliminary studies in our lab have shown that this unusual mechanism of yolk cellularization and mobilization also occurs in snapping turtles (*Chelydra serpentine*) and fence lizards (*Sceloporus undulatus*). Such findings indicate that this pattern of yolk processing may be ancestral for all Reptilia. Studies of this developmental mechanism offer information on patterns from which viviparity has evolved and contribute to an understanding of reptilian evolutionary history.

Keywords: oviparity, yolk sac, angiogenesis, endodermal cells, viviparity

15.
INVESTIGATING MITOSIS IN THE GROWTH ZONE OF TRIBOLIUM CASTANEUM AND THAMNOCEPHALUS PLATYURUS DURING SEGMENTAL DEVELOPMENT
Phong Quach '17
Faculty Sponsor: Terri Williams

Despite a growing understanding of segmental gene patterning in major arthropod groups, the cellular mechanism of elongation during segmentation within the posterior growth zone are not completely understood. Based on classical observations, a continuous and high rate of mitosis in the posterior growth zone is assumed to drive elongation during segmentation. In this study, we tested that assumption by measuring mitosis within the posterior growth zone of two arthropod species, *Tribolium casteneum,* the red flour beetle, and *Thamnocephalus platyurus*, the fairy shrimp. To observe potential mitotic domain in the growth zone, mitotic cells were alternatively visualized by either α-pH3 immunohistochemistry or Click-iT® EdU Alexa Fluor® system. Furthermore, in *T. platyurus*, the potential role of mitosis regulators such as *string, cyclin A, B* and *E* in the growth zone were visualized through whole mount *in situ* hybridization. In *T. castaneum*, the function of mitosis in the growth zone was explored using gene knockdown of *string* (RNA interference). Despite the failure to visualize the mitotic configuration within the growth zone of the *T. castaneum* embryo, mitosis was found to be important for normal development as knockdown of *string* produced aberrant embryonic phenotypes. In *T. platyurus*, a localized zone of mitosis was discovered in the posterior region of the growth zone followed by an anterior quiescence zone in which cells were arrested in S phase. The results in *T. platyurus* were consistent with a model of low rates of cell cycling in the posterior, and provided preliminary estimates of cell cycle in the growth zone. In conclusion, neither species showed the predicted continuous and high rates of mitosis in the posterior growth zone.

16.
LUCIBUFAGINS (FIREFLY DEFENSIVE STEROIDS): PHYLETIC DISTRIBUTION AND BIOSYNTHESIS
Kathareeya Katie Tonyai '17
Faculty Sponsor: Scott Smedley

Predation is a powerful ecological factor. In response to predators, prey organisms adapt defensive strategies over evolutionary time. Several firefly species are chemically protected and use a mixture of defensive steroids called lucibufagins (LBGs), which are affective against generalist predators. It was hypothesized that *Pyractomena*, a previously unexamined genus, is chemically defended due to their aposematic coloration, and unusual arboreal pupation, which exposes them to predators. Last-instar *Pyractomena borealis* larvae were collected in the field and reared to adulthood in the lab. Emerged adults were analyzed using HPLC-MS, and 1D and 2D NMR. The resulting data supported our hypothesis, identifying a minimum of five LBGs in *P. borealis*. Successful establishment of a lab colony of *P. borealis*, the first such colony for North American firefly species enabled a LBG biosynthesis experiment that was conducted using the reared larvae. The biosynthesis of LBGs remains unknown despite their significance in firefly defense. Chrysomelid beetles synthesize cardenolides (structurally related to LBGs) from cholesterol via *de novo* synthesis. Consequently, I wanted to determine if *P. borealis* could synthesize LBGs from cholesterol. *P. borealis* larvae were fed labelled $(3,4-{}^{13}C_2)$ or unlabeled cholesterol and were analyzed for ${}^{13}C$ incorporation into their LBGs using HPLC-MS. Mass shift proportions for two

LBGs (LBG 449 and 533) showed a significant incorporation of two C^{13} into their LBGs (P = 0.0028; P = 0.001, respectively), confirming our hypothesis of de novo synthesis with a cholesterol precursor. Since LBG 449 is not acetylated unlike LBG 533, the incorporation of C^{13} suggests that the four carbon rings of cholesterol construct the steroid core of the LBGs. Further studies will determine if the biosynthesis of LBGs within these fireflies could involve a microbial endosymbiont.

17.
THE EFFECT OF LEAD (II) NITRATE ON THE GROWTH RATE OF *NAVICULA* SP. *IN VITRO*
Chris Whelan '18, Myles Walsh '19
Faculty Sponsor: Craig W. Schneider

There is strong evidence to support the claim that lead is a known toxin and that it can negatively impact natural processes within algae, such as photosynthesis, respiration, as well as viability, reproduction and motility. This study was designed to highlight the effects of Lead (II) nitrate $(Pb(NO_3)_2)$ on a specific strain of *Navicula*, a common diatom in the plankton. Cultures were incubated in Bold's Basal medium at 20ºC with a 16L:8D photoperiod and 8 mL of Bold's Basal medium were mixed with 1 mL of the culture and 1 mL of differing concentrations of Lead (II) nitrate $(Pb(NO_3)_2)$: 0, 50, 100, 150 and 200 µg/mL. Chlorophyll b concentrations *in vitro* were measured over the course of 7 da using a fluorometer to observe the effects of lead on population growth of this alga. Our results showed that there was no significant difference in growth rate of this strain of *Navicula* when exposed to $Pb(NO_3)_2$. It is possible that the concentrations of lead were not high enough to elicit a response from the alga, or that lead simply does not alter metabolic function and division in this diatom.

18.
THE EFFECTS OF CIGARETTE LEACHATE ON PERIDINIUM
Haley Willis '18, Graham Turner '18
Faculty Sponsor: Craig W. Schneider

Cigarette butts are the United States most common litter product. They find their way into the banks of rivers, lakes and oceans, where their chemical composition can be absorbed into the aquatic environment. Nicotine is not the only toxic chemical that cigarettes contain, rather, with every littered cigarette comes the addition of heavy metal compounds, ammonia, arsenic, formaldehyde, and monoammonium phosphate as well. Cigarettes could possibly be a contributor to harmful algal blooms worldwide, due to their effect on algal population growth rates. The test subject, *Peridinium* is a species of freshwater dinoflagellates that have fluorescent properties. Under the right conditions, they are susceptible to growing into large blooms. Harmful blooms of various dinoflagellate and diatom species, whether poisonous or physically disruptive, have lead to the destruction of both freshwater and saltwater ecosystems, and can heavily limit commercial fish and shellfish industries worldwide.

The experiment focused on the effect of cigarette butt leachate on *Peridinium* growth by comparing the population growth rate of colonies that were grown in various strengths of leachate. The cultures were grown in Bold's Basal medium and distilled water, at 20°C with 12 hours of sunlight for 96 hours. The fluorescence of each solution was tested every 24 hours with the Aquafluor

fluorometer, reported in μg/L. *Peridinium* showed a higher rate of growth as cigarette concentrations increased. At the highest concentration of cigarette leachate, the growth of *Peridinium* plateaued at approximately 72 hours. Increased levels of cigarette leachate significantly affected the population growth rates of *Peridinium* (p = 0.043). The results found were most likely due to the increase in phosphate available in the cultures with higher leachate concentrations.

CHEMISTRY

19.
PURIFICATION USING SODIUM BISULFITE AS AN ALDEHYDE SCAVENGER
Maria Boucher '20
Faculty Sponsor: Cheyenne Brindle

The purification and separation of substances to eliminate impurities is extremely important in organic chemistry. We are developing an extraction protocol that relies on the use of sodium bisulfite as an aldehyde scavenger. Equal amounts of substrate and aldehyde were mixed in a miscible layer and then sodium bisulfite was added to create a bisulfite adduct. Then, equal amounts of distilled water and organic solvent were added to separate the substrate and aldehyde bisulfite adduct into organic and inorganic phases respectively. These phases were then separated and the substrate was removed from the solvent. The amount of aldehyde impurity removed from the substrate was determined through NMR analysis and the amount of substrate recovered was determined through massing the final amount of substrate and comparing this to the amount initially used. The data I collected shows that our procedure removes the aldehyde successfully from amines, epoxides, and alkenes. Furthermore, our data shows that this procedure allows for high percentages of recovery of amines, epoxides, and alkenes, except for one epoxide substrate tested. Future work is aimed at testing the scope of the workup protocol with respect to alkene and alkyne functionality, as these substrates are known to react with sulfur dioxide, which is present in aqueous sodium bisulfite.

20.
EFFECT OF SUPPORTED BILAYER COMPOSITION ON FUNCTION IN MICROFLUIDIC DEVICES
Julia Clapis '18
Faculty Sponsor: Michelle L. Kovarik

The research goal is to study the effect that the purity of a phosphatidylcholine supported bilayer membrane has on its function in a microfluidic device. The small size of the channels in these devices make them susceptible to fouling or blockage, by cells or biomolecules, rendering them useless. A common solution to this problem is to coat the inside of the channel with a semipermanent coating, such as a supported bilayer membrane. These coatings consist of a double layer of phospholipids arranged tail to tail. Due to the amphiphilic nature of lipids, they form multilamellar vesicles that can be sonicated to small unilamellar vesicles, which adhere to hydrophilic surfaces and spontaneously rupture and coat them. Phosphatidylcholine is a commonly used lipid for this application because its zwitterionic headgroup makes coatings particularly resistant to fouling. In this work, phosphatidylcholine was extracted from chicken eggs and purified using an alumina column to separate the desired palmitoyl/oleoyl chain lipids from the

undesired stearoyl/linoleoyl lipids. Small unilamellar vesicles were made from the lipid before and after column purification to determine the effect of the presence of SLPC or other lipids in the bilayer. Hybrid PDMS-glass microchips were coated with the lipid to allow the bilayer to form before being filled with two slightly different concentration buffers for measurement of electroosmotic flow by the conductivity method. Electroosmotic flow is a good indicator of bilayer degradation because the presence of the bilayer reduces the charge density of the channel walls, reducing the electroosmotic flow. A Y-shaped channel design allowed for repeated displacement of the two buffers without mixing between them. In this fashion, we are continuing to evaluate the integrity of the supported bilayer membrane as a function of lipid purity.

21.
EXAMINING THE SYNTHESIS OF BUCKMINSTERFULLERENE (C60)
Grant Collins '17, Matt Lucas '17
Faculty Sponsor: Cheyenne Brindle

The retro synthesis and key mechanistic steps for the full synthesis of Buckminsterfullerene (C60), chemistry's soccer ball, are presented.

22.
SINGLE-CELL ANALYSIS OF *DICTYOSTELIUM DISCOIDEUM* USING MICROCHIP ELECTROPHORESIS
Jessica Duong '19
Faculty Sponsor: Michelle L. Kovarik

The major goal of the single cell analysis field is to detect subpopulations of cells of differing phenotypes within a larger population. Since this is a relatively new field, data analysis methods are still being formalized. This study aims to use model data sets to evaluate statistical tools for single cell analysis. In particular, single cells of the amoeba *Dictyostelium discoideum* were analyzed using microchip electrophoresis to measure model analytes, fluorescein and carboxyfluorescein dyes. The cells were incubated with the dyes in the dark for 20 minutes before being lysed by an electric field (330 V/cm) and detected by laser-induced fluorescence using a PMT. Dye ratios from preliminary experiments show lower intraday variation than interday variation, suggesting cell populations differ between days. Further work will be directed towards optimizing the experimental methods to increase throughput and measure larger numbers of cells for statistical analysis. Ultimately, histograms of the single cells will be used to characterize the population distributions and to elucidate the factors necessary to identify low-abundance subpopulations.

23.
RETROSYNTHETIC ANALYSIS OF PROSTAGLANDIN F2α
Paul Handali '18, Josephine Frempong '18
Faculty Sponsor: Cheyenne Brindle

Prostaglandins are a group of physiologically active lipid compounds which have a variety of hormone-like effects in animals. They are compounds of 20 carbons which includes a five-membered ring. Prostaglandin F2α specifically is used in medicine to induce labor. Robert

Woodward's synthesis of Prostaglandin F2α will be retrosynthetically analyzed, and mechanisms for key steps in the synthetic process will be described in detail.

24.
EFFECT OF FIRST VT EPISODE TO ABLATION TIME ON VT RECURRENCE IN PATIENTS WITH STRUCTURAL HEART DISEASE
Josephine Frempong '18
Faculty Sponsors: Alison Draper, Maryann McGuire, RN MPH, Edmond Cronin, MD FHRS CCDS, Hartford Hospital.

Ventricular Tachycardia (VT) is an abnormal heartbeat with three or more consecutive beats originating from ventricles independent of the atrial or atrioventricular (AV) nodal conduction. Exposure to these abnormal heart rates for more than a few hours, termed as sustained VTs, is more frequent in patients with a prior myocardial infarction (MI) due to the complexity of the substrate, and may lead to sudden cardiac death. Catheter ablation (CA) involves placing a catheter, into the heart from the artery or vein in the groin, to identify and ablate (destroy), the origin of a VT using radiofrequency.

CA for VT in normal heart structures yields about a 90-95% complete cure of VT while for post infarction VT usually has about 40-50% complete cure with many patients experiencing a recurrence. CA for VT is an evolving field and data lags that for other ablation procedures such as supra-ventricular tachycardia and atrial fibrillation. Thus, this study seeks to identify if earlier or later CA after VT in post infarction VT patients, has any effect on the time of recurrence and the number of recurrences of the VT.

Retrospective chart review of all patients with structural heart disease that had a VT ablation, for a sustained VT, at Hartford Hospital (HH) from 2013 to 2016, inclusive, was done. A time-to-event analysis compared procedural outcomes such as rates of VT recurrence over total follow-up time (minimum 6 months) after the initial and last ablation procedure, the procedure complication rate and the success rate post ablation. Post-infarction VT and VT in patients with non-ischemic cardiomyopathy were analyzed as subgroups. Results, presented descriptively, highlight trends of high procedural success rate and low VT recurrence rate. Further research will help us generate hypothesis to set the stage for future retrospective studies.

25.
SEPARATION OF ALDEHYDES AND KETONES FROM VARIOUS ORGANIC SUBSTRATES BY EXTRACTION
Max Furigay '19
Faculty Sponsor: Cheyenne Brindle

Purification techniques such as distillation, recrystallization, or column chromatography can be time consuming, wasteful in terms of atom efficiency, or complicated to perform, whereas extraction is relatively quick and easy. By reacting certain aldehydes with saturated sodium bisulfite, it is possible to extract these carbonyl compounds into an aqueous solvent layer. However, some carbonyl compounds, such as ketones, do not react with bisulfite, allowing them to remain in an organic layer and allowing a separation of these fairly similar carbonyl compounds

through extraction. This term's research focuses on determining how steric hindrance effects reactivity in this process. By first synthesizing non-volatile, sterically hindered aldehydes, and then comparing their recovery rates, it was determined that these aldehydes yield much lower removal rates compared to sterically unhindered aldehydes such as anisaldehyde.

26.
SYNTHESIS AND CHARACTERIZATION OF CYCLIC ORGANOMETALLIC PEPTIDES
Cosmic Gober '18
Faculty Sponsor: Timothy P. Curran

The objective of this project is to synthesize and characterize organometallic peptides that have the potential to adopt □-sheet conformations. The desired organometallic peptide contains a bimetallic ring system that has a ferrocene unit at one end, a tungsten bis-alkyne at the other end, and two peptide chains attached to the two alkynes. To synthesize this complex, we needed first to form a ferrocene diamide and an alanine derivative acylated with 4-iodoaniline. These two molecules are coupled together through a Sonogashira reaction. Finally, the resulting dialkynylpeptide is reacted with $W(CO)_3(dmtc)_2$ to produce the bimetallic ring system. The intermediate and final compounds were characterized for purity using TLC and HPLC. The identities of the intermediate and final compounds were established by ^1H NMR, ^{13}C NMR and MS. Whether the final product adopts a β-sheet conformation can be determined using NMR and X-ray crystallography. Details regarding this work will be presented.

27.
SYNTHESIS OF IMINES FOR THEIR EVENTUAL USE IN A SINGLE ADDITION REACTION OF AN INDOLE AND A BENZALDEHYDE
Melissa Guarino-Hotz '17
Faculty Sponsor: Cheyenne Brindle

The synthesis of imines was optimized for their eventual use in a single addition reaction between an indole and a benzaldehyde. Each reaction sought to find the best starting reactants, solvent, drying agent, and recrystallization method to yield a pure imine product. The purity of the product was determined using Thin Layer Chromatography and ^1H Nuclear Magnetic Resonance. The reaction was successful using *para*-cyanobenzaldehyde, dichloromethane, 3 Å molecular seives, and a recrystallization in hexanes.

28.
OSMOTIC LYSIS OF PINOSOMES IN *DICTYOSTELIUM DISCOIDEUM*
Grigorii Kalminskii '20
Faculty Sponsor: Michelle L. Kovarik

Loading molecules into living cells allows one to monitor cellular metabolism, track various metabolic pathways and modify cellular activity. In order to successfully load exogenous molecules, one selects an optimal loading method and identifies the optimal conditions. The ideal, optimized loading method will produce rapid, uniform, controllable loading of a wide range of

molecules with minimal reagent consumption, analyte degradation, and cell stress. In this experiment, we examined a promising loading method called osmotic lysis of pinosomes or pinocytic loading using the model organism and social amoeba *Dictyostelium discoideum*. This method is based on the pinocytosis of molecules from the hypertonic loading medium followed by resuspension of the cells in hypotonic medium, which causes lysis of hypertonic pinosomes and consequent release of the loaded molecules into the cell's cytosol. To optimize loading, several experimental conditions were manipulated: molecular concentration, osmolarity of the loading and resuspension media, and incubation time. Effects of these variables were evaluated using quantitative fluorescence microscopy to assess the intensity of fluorescence from tagged peptides and fluorescent dyes loaded into the cells and the cells' viability after the procedure. It was determined that detectable amounts of dyes were loaded into the cells through pinocytic loading with dye concentrations as low as 50 μM and with incubation time as short as 20 minutes. Ongoing work is exploring the role of osmolarity on loading and subsequent cell viability. Further work will focus on comparing pinocytic loading to other loading methods, such as electroporation and myristoylation.

29.
INSERTION OF EXOGENOUS MOLECULES INO *DICTYOSTELIUM DISCOIDEUM* USING ELECTROPORATION

Joshua D. Knopf '17
Faculty Sponsor: Michelle L. Kovarik

Peptide substrate reporters are traditionally used in one of two ways: in lysates or in intact cells. In either case, the peptide substrate reporter is mixed with active enzyme and co-factors for a fixed incubation period after which a separation is performed. The relative peak areas of the unmodified reporter and any enzyme products are used to quantify enzyme activity. In general, assays conducted in intact cells are preferred, as this preserves *in vivo* regulatory mechanisms such as localization; however, peptide substrate reporters are not generally membrane permeable. Electroporation is a well-established method of loading exogenous molecules into cells for transfection. In this work, we explore electroporation as a means to load a peptide substrate reporter for protein kinase B (PKB) into the social amoeba *Dictyostelium discoideum*. A Design of Experiments method was used to optimize the electroporation parameters using fluorescein as a model analyte. The variables being optimized through this analysis are electroporation buffer composition, dye concentration (20 μM or 60 μM), number of electroporation pulses (1 to 3 pulses), cell density (5-30 million cells/mL), and exponential vs square wave pulsing. The square wave electroporation procedure using H50 buffer and a dye concentration of 50 μM has given promising results. Once the electroporation procedure is optimized, quantitative fluorescence microscopy, plate reader assays and capillary electrophoresis will be used to quantify loading and the degradation pattern of the peptide substrate reporter after it is loaded into live, intact *D. discoideum* cells.

30.

DETECTION AND DISCRIMINATION OF COUNTERFEIT PHARMACEUTICALS USING DIRECT ANALYSIS IN REAL TIME /TIME-OF-FLIGHT MASS SPECTROMETRY WITH MULTIVARIATE STATISTICAL ANALYSIS

Jacqueline Kromash '19, Thomas Naragon '17, Matthew Lucas '17
Faculty Sponsors: Janet F. Morrison, Kirsti A. Wash, Robert B. Cody, Brian F. Donnelly, Amy C. Callahan, Brian Musselman

In recent years, counterfeit pharmaceuticals have increased in both popularity and availability, with on-line sellers offering low prices, fast delivery, and discreet purchasing of medications without the need for a doctor's prescription. In addition to significant revenue losses for pharmaceutical companies, these drug 'fakes' pose dangerous health risks to consumers, since their composition is varied and unregulated. Sildenafil citrate, a prescription medication used to treat erectile dysfunction, is one of the most commonly counterfeited drugs worldwide. This study employs direct analysis in real time—time of flight mass spectrometry (DART-TOFMS) combined with multivariate statistical analysis for the determination of sildenafil citrate tablet authenticity, and evaluates the potential of this methodology for distinguishing illicit manufacturing source.

The rapid ambient ionization associated with DART, combined with the inherent high mass accuracy of TOFMS, suggest the suitability of this technique for high throughput screening of pharmaceutical authenticity by eliminating the need for sample preparation and chromatographic separation. In this study, mass spectra were obtained for authentic sildenafil citrate tablets as well as 85 pills obtained from ten separate counterfeit drug seizures. In-source collision induced dissociation (CID) was performed at an MS inlet voltage of 20V for powdered tablets. The resulting DART-TOFMS chemical signature data were processed using Linear Discriminant Analysis (LDA) and Support Vector Machine (SVM) analysis evaluated to determine which conditions provide the most discriminating information in terms of authentication, differentiation, and potential for identifying manufacturing source.

31.

SYNTHESIS OF MOLYBDENUM COORDINATED FERROCENE DIAMIDE COMPLEX

Ian Langer '17
Faculty Sponsor: Timothy P. Curran

This study attempted to synthesize and examine the structural conformation of a molybdenum ferrocene-diamide complex. Previous work in the Curran lab has centered around the established tungsten ferrocene-diamide complexes due to their rigid conformation and cyclic nature, along with applications as a template for the formation of ß-sheets. First, following literature procedures, two precursors were synthesized, starting with $Mo(CO)_6$ in order to form the first precursor $Mo(CO)_2(S_2CNMe_2)_2$, and 1,1'-ferrocenedicarboxylic acid to form the second precursor, ferrocene diamide. Next, by dissolving the precursors in degassed methanol and methylene chloride and reacting them under reflux in a nitrogen gas environment, the desired molybdenum complex was formed. Following purification via column chromatography, its structure was confirmed utilizing ^{1}H NMR. Future work will involve further structural analysis, such as NMR experiments including ^{13}C, DMSO hydrogen bond titration, and 2-D COSY, mass spectrometry, and X-ray crystallography.

32.
COMPARISON OF MULTIVARIATE STATISTICAL ANALYSIS APPROACHES APPLIED TO DART/TOFMS DATA FOR THE CHARACTERIZATION OF COUNTERFEIT PHARMACEUTICALS

Thomas Naragon '17, Jacqueline Kromash '19
Faculty Sponsors: Janet Morrison, Robert Cody, PhD - JEOL USA, Inc., Peabody, MA 01960

The use of direct analysis in real time/time of flight mass spectrometry allows for rapid throughput of large sample sets. Due to the complexity of the data obtained by the method, multivariate statistical methods are required to study inter-sample similarity and complex sample characterization. The advantages of different modes of dataset compression were compared in the analysis and sample classification of a set of authentic and ten sets of counterfeit Viagra. The overarching challenge of the study was to develop an analysis scheme that avoids over-fitting the available data, given the small sample size, as well as under-fitting the data, using too stringent of preprocessing and compression.

The goal of the study was to determine the combination of analysis methods that would result in the greatest classification accuracy on a set of unknown counterfeit and authentic pills. Principal component analysis and linear discriminant analysis were used to compress data down to three dimensions and Euclidean distance, z-score distance, and one-vs-all logistic regression methods were used to classify unknown samples. Neural networks were also considered as a classification method. The z-score distance classification method in concert with principal component analysis and the neural network method were the two most accurate methods.

33.
REACTION OF INDOLE AND BENZALDEHYDE USING MALACHITE GREEN-TRIPHENYLMETHYL (TRITYL) CATIONS AS ACTIVATOR

Wilfried Nganyak Tentchou 'IDP
Faculty Sponsor: Cheyenne Brindle

Triarylmethyl cation catalysts (TCCs) organocatalysts were used as activators to perform green chemical reactions with indole derivatives and benzaldehyde. Previous research in our lab has shown that sodium bisulfite is effective in isolating a crude product from a reaction mixture containing aldehyde impurities. This protocol was applied to the reactions of 2-methylindole and 3-methylindole with benzaldehyde using TCC catalysis. The crude products were characterized and analyzed using thin layer chromatography, ^{1}H and ^{13}C NMR spectroscopy and gas chromatography-mass spectrometry. The protocol was optimized with respect to the solvent for the 2-methylindole product. Future work will be aimed at optimizing the protocol for the 3-methylindole product.

34.

SYNTHESIS AND EVALUATION OF ALKYNYL β-SHEET MIMETICS COORDINATED TO TUNGSTEN

Elena-Marie C. Pedro '17, Shawna M. Berk '13, Adam N. Boynton '12
Faculty Sponsor: Timothy P. Curran, James N. and Florence V. Frank Research Fellowship

Understanding the behavior of β-sheet proteins and their aggregation is an interesting area of study due to the possible correlation of the aggregates with neurodegenerative diseases such as Alzheimer's disease. Studying anti-parallel β-sheet peptidomimetics could reveal information which aids in understanding the aggregation process of β-sheet proteins. The aim of this study was to determine if peptide derivatives of 2-amino-2'-carboxydiphenylacetylene maintain their β-sheet arrangement when coordinated to tungsten. In the initial investigations, peptide derivatives of 2-amino-2'-carboxydiphenylacetylene were synthesized and coordinated with tungsten to form mono-alkyne complexes. The purified complexes were examined for purity using HPLC, and their molecular composition and conformation were determined using MS and NMR. It was discovered that these complexes adopted anti-parallel β-sheet arrangements. In further work the same peptide derivatives were coordinated with tungsten to form a bis-alkyne complex (A) and it was examined using HPLC, MS and NMR. It was discovered that the bis-alkyne complex did not maintain its antiparallel β-sheet conformation. Details regarding this work will be presented.
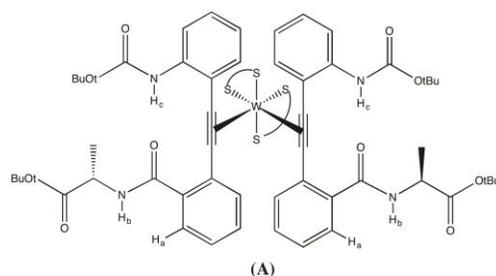
(A)

35.

SYNTHESIS AND CHARACTERIZATION OF PEPTIDE DERIVATIVES OF A CONSTRAINED BIMETALLIC RING SYSTEM

Michael Phillip '19
Faculty Sponsor: Timothy P. Curran

The overall goal of the experiment is to create a model beta sheet by attaching peptides to a bimetallic ring system. Using the model bis-alkyne tungsten complex synthesized by Allison Lawrence as a framework, Niru Pokharel and Lauren Davidson briefly investigated if the rigidity of the model complex was affected by the groups attached to the alkyne group. It was found that the attachment of different groups to the alkyne group did not affect the rigidity of the model complex. The aim of this experiment was to characterize the valine derivative of the bis-alkyne complex synthesized by Niru Pokharel. The bis-alkyne derivative was synthesized by reacting ferrocene diamide with the valine derivative. To synthesize the tungsten complex, the dialkynylpeptide derivative of valine was reacted with $W(dmtc)_2(CO)_3$. The resulting compounds from both reactions were purified using flash chromatography. After purification, both the dialkynylpeptide derivative of valine and the tungsten complex were characterized using ^{1}H NMR and ^{13}C NMR. The synthesis and characterization of the dialkynylpeptide derivative of valine will be described in this poster.

36.
SYNTHESIS OF TURBOMYCIN B ANALOGUES FOR THE DEVELOPMENT OF NOVEL ANTIBIOTICS
Phong Quach '17
Faculty Sponsor: Cheyenne Brindle

In recent years, cases of death caused by bacteria exponentially increased, due to the lack of novel antibiotic agents coupled with the swift emergence of antibiotic resistance. Despite the imminent need to develop new treatments, the task of discovering novel antibacterial compounds has become extremely challenging due to the high rate of rediscovery. From a metagenomic study in 2002, Gillespie *et. al.* found that turbomycin B, which was isolated from soil bacteria, displayed a broad spectrum of antibiotic effects toward both Gram positive and Gram negative bacteria. Despite the promising biological activity of this novel compound, it's structure-activity relationship has not been determined. By creating analogues of turbomycin B, the consequences of modifications of the indole and aldehyde portions of the compound on its biological activities were investigated. Previously, it was found that an N-isopropyl indole modification on the adduct optimally enhanced the biological activity of the compound on Gram positive and pathogenic fungal agents. Thus far, we have synthesized an array of analogues derived from N-isopropyl indole to probe the steric and electronic effects of the phenyl components. The compounds will be tested on a variety of bacterial strains to assess the phenyl component optimization.

37.
SYNTHETIC ANALYSIS OF (Z)-N-((1R,2R,6S)-6-AMINO-4-(ETHOXYCARBONYL)-2-(PENTAN-3-YLOXY)CYCLOHEX-3-EN-1-YL)ACETIMIDIC ACID (OSELTAMAVIR)
Phong Quach '17, Kathy Rodogiannis '17
Faculty Sponsor: Cheyenne Brindle

Elias Corey's total synthesis of the antiviral medication used to treat influenza, Oseltamavir, will be analyzed retrosynthetically. The NMR data prove the synthesis successfully created the target molecule.

38.
SINGLE CELL ANALYSIS OF REACTIVE OXYGEN SPECIES IN *DICTYOSTELIUM DISCOIDEUM*
Kathy Rodogiannis '17
Faculty Sponsor: Michelle L. Kovarik

Chemical analysis of individual cells is necessary to better understand heterogeneity in a population of cells. Despite genetic and environmental uniformity, there is inherent variation in individual cells that causes biological noise. This variability may be adaptive since it ensures a population of cells produces a range of responses to environmental stresses, such as oxidative stress. In our research we are using a microfluidic device for single cell analysis. The device integrates cell transport, lysis, injection of fluorescent dyes, and the electrophoretic separation of the dyes. In preliminary experiments, the cells are labeled with 2′, 7′-dichlorofluorescin diacetate (DCFH$_2$-DA) and carboxyfluorescein diacetate (CFDA) as an internal standard. Cells treated with 60mM hydrogen peroxide (X=101) displayed higher DCF peak areas and a higher DCF/CF peak area ratio, indicating the presence of increased reactive oxygen species then untreated cells (X=52).

Based on the distribution of the dye ratios, the hydrogen peroxide treated cells appear to be more heterogeneous than the native sample. Additional data needs to be collected to estimate population variability in cellular response to oxidative stress.

39.
DEVELOPMENT OF A DART-TOFMS METHOD FOR THE DETECTION OF ETHYL GLUCURONIDE IN AQUEOUS BIOLOGICAL SAMPLES
K. Ana Romano '18
Faculty Sponsor: Janet F. Morrison

Ethyl glucuronide (EtG) is a minor metabolite of ethanol that is formed from the conjugation of ethanol with glucuronic acid in the liver. Approximately 0.02% of ethanol is converted to EtG and is excreted into urine, breath, blood, hair, and oral fluid. Depending upon the level of alcohol consumption, EtG can be detected for up to a few days following alcohol consumption, while ethanol can only be detected for a few hours. EtG is a preferred biomarker employed by many toxicology and forensic laboratories as an indicator of ethanol exposure, especially in cases pertaining to alcohol dependence, detoxification programs, and even transplant treatment centers. The overall goal of this project is the development of a rapid and sensitive method based on direct analysis in real time/time of flight mass spectrometry (DART-TOFMS) for the detection and quantification of EtG in biological samples. Compared with conventional GC-MS approaches, DART-TOFMS offers several advantages, including ambient ionization, relatively simple mass spectra composed of $[M+H]^+$ peaks in positive ion mode or $[M-H]^-$ peaks in negative ion mode, and high mass accuracy associated with the TOF mass analyzer, which eliminates the need for chromatographic separation. The results of a variety of DART-TOFMS experiments designed to uniquely characterize EtG will be presented, including derivatization approaches, sample pre-concentration by solid phase microextraction, oxygen adduct formation, and comparison of positive vs. negative ion acquisition modes.

40.
PROGRESS TOWARD THE PREPARATION OF ALKYNE PEPTIDE DERIVATIVES THAT ADOPT A PROPOSED BETA SHEET CONFORMATION WHEN COORDINATED TO TUNGSTEN
Joseph P Sanderson-Brown '18
Faculty Sponsor: Timothy P. Curran

Dialkynyl peptides bonded to ferrocene have been shown to cyclise into bimetallacyclic complexes when coordinated to tungsten. The molecule 1,1'-ferrocenedialkynyldiamide has further been shown to adopt an anti-parallel β-sheet conformation when cyclised using tungsten. The intramolecular bonding between the amide groups of the peptide chains determine the conformation and orientation adopted. Alanine and phenylalanine peptide derivatives and an acetyl derivative of 1,1'-ferrocenedialkynyldiamide were explored to determine if a similar β-sheet conformation could be adopted. A commercially available alanine derivative, Boc-Ala-OSu, was reacted with 1-amino-4-chloro-2-butyne under basic conditions (Et_3N) in an unsuccessful attempt to form Boc-Ala-NHCH$_2$CCCH$_2$Cl. A commercially available phenylalanine derivative, Boc-Phe-ONp, was reacted with 1-amino-4-chloro-2-butyne under basic conditions (Et_3N) to yield Boc-Phe-NHCH$_2$CCCH$_2$Cl. The chlorine of the Boc-Phe-NHCH$_2$CCCH$_2$Cl was substituted via an overnight reaction with NH$_3$ in MeOH at 80°C to yield Boc-Phe-NHCH$_2$CCCH$_2$NH$_3$Cl. The

substitution reaction was followed by the coupling of Boc-Phe-NHCH$_2$CCCH$_2$NH$_3$Cl to a prepared ferrocene diacid chloride using DIEA in DMF. The resulting ferrocene-coupled dialkyne was coordinated to W(dmtc)$_2$(CO)$_3$ in refluxing MeOH and under anaerobic conditions. Spectroscopic data, including a high temperature HNMR, suggests that the final bimetallic complex was formed, but that it is more flexible than anticipated. The acetyl group was inserted by replacing the peptide derivative starting reagent with acetic anhydride and following the same synthesis pathway used for Boc-Phe-ONp. Synthesis of the amine and subsequent synthesis of the ferrocene-coupled dialkyne were both believed to be successful. Current works revolves around W(dmtc)$_2$(CO)$_3$ coordination of the acetyl dialkyne. Future work will be the characterization of the final product and the determination of its conformational flexibility. All structures of the products of the synthetic pathways were confirmed using electrospray mass spectrometry and proton NMR spectroscopy.

41.
RETROSYNTHETIC ANALYSIS OF EJ COREY'S TOTAL SYNTHESIS OF LACTACYSTIN
Joseph P. Sanderson-Brown '18
Faculty Sponsor: Cheyenne Brindle

EJ Corey's total synthesis of the proteasome inhibitor Lactacystin will be analysed retrosynthetically. Spectroscopic data of a different total synthesis of the same molecule by Masakatsu Shibasaki will also be analysed.

42.
SYNTHESIS, ANALYSIS AND REACTIVITY STUDIES OF RHENIUM COMPLEXES SUPPORTED BY BIDENTATE PHOSPHINES
Adam Thibodeaux '17, Nikola Mizgier '19
Faculty Sponsors: Maria Parr, Vindya Thilakarathne

Rhenium complexes have a number of important applications in catalysis and in the development of radiopharmaceuticals. Bidentate phosphine ligands such as dppb and biphep have been used as supporting ligands in the synthesis of a series of rhenium-oxo complexes. The characterization of these complexes was carried out using FTIR, multinuclear NMR spectroscopy and X-ray diffraction. Computational studies based on Density Functional Theory using the General Atomic and Molecular Electronic Structure System (GAMESS) and Avogadro software systems were carried out. It was found that not only sterics, but also the electronic environment around the chelating ligand and its bite angle (β_n) affect the stability and functional properties of the resulting complexes. The collected observations and numerical data can be used in predicting the physical properties of metal-oxo complexes supported by a wide variety of ligands. The reactivity of these complexes in epoxidation reactions was also explored.

43.
MYRISTOYLATION METHOD FOR INSERTING A PEPTIDE SUBSTRATE REPORTER INTO *D. DISCOIDEUM*
Allison J. Tierney '17
Faculty Sponsor: Michelle L. Kovarik

Introduction of exogenous molecules through the cell membrane is important as a means of transmitter, hormone and drug discovery research. While our previous work has loaded a peptide substrate reporter into cell lysates, the current goal is to insert a fluorescently-labeled reporter into intact *D. discoideum* cells with the help of a myristol group. A peptide substrate reporter is a fluorescently labeled peptide that can be acted upon by one or more enzymes of interest. A myristol group is a hydrophobic fatty acid chain that can permeate the plasma membrane bilayer; it can be attached to the peptide via a disulfide bond that is broken in the reducing environment of the cell. We have been optimizing loading conditions with the goal of being able to control loading concentration while limiting the stress on the cell and degradation of the reporter. We used a plate reader to measure loading of the peptide into cells as a function of both time and external concentration. We observed that loading time had no strong effect on the internal concentration of loaded peptide, but the concentration of peptide inside the intact cell increases as the concentration of peptide present outside increases. Consequently, we determined that the optimal way to control the amount of peptide loaded in the cell is by changing the concentration outside the cell rather than the loading time. To better quantify the concentration of peptide inside the cells, we analyzed lysed cells via capillary electrophoresis. Using a calibration curve of external standards, we estimated the internal concentration of peptide in cells after loading is roughly equal to the concentration of peptide applied outside the cell. Capillary electrophoresis was also used to assess the enzymatic degradation of the reporter in the cells. The degradation of the myristolated reporter was measured over time (t = 0, 15, 30 and 60 min). Reporter degradation increased as the reporter spent more time in the cell with an approximate half-life of 15 min, and qualitative differences were observed between degradation in cell lysates and degradation in intact cells. Future work will access the uniformly of reporter loading within individual cells; evaluate phosphorylation of the reporter by a kinase in intact cells; and compare loading of the myristolated peptide to loading via pinocytosis and electroporation.

COMPUTER SCIENCE

44.
LOCAL-E: CONNECTING YOU BACK TO YOUR COMMUNITY
Pranav Bhandari '17
Faculty Sponsor: Peter Yoon

Local-E is a location based forum website built using a JavaScript framework called Meteor. The app delivers curated local content to the users by filtering the content based on their location. The users are able to create or subscribe to channels that they are interested in. Each channel is a forum on a certain topic and it will contain posts related to that topic where the users can communicate through comments like in reddit. The users have access to two kinds of feed which consists of local content: main feed and curated feed. While both feeds only contain content from the area around the user, the curated feed filters the content further based on the communities that the user has subscribed to.

45.
AN ANALYSIS OF POLITICAL SOCIAL MEDIA DATA USING NATURAL LANGUAGE PROCESSING
Rahul Chandrashekhar '17
Faculty Sponsor: Peter Yoon

The increase of filtered content on the internet, particularly on social media, has left internet users in a "bubble". In this bubble, the users only see such political content that aligns with their biases while the content with alternate viewpoints is filtered out. The recent election period was one which saw various prominent politicians use the power of social media to reach out to voters. As a result, there is an abundance of data coming in from political parties and figures. This study uses the power of Natural Language Processing and Machine Learning to analyze the opinions and views of politicians on Twitter in an attempt to reveal interesting trends and uncover biases. The Twitter API was used to download Tweets and articles over a 10 month period and organized in the form of a database. All the collected data was then preprocessed to filter out unnecessary terms while leaving only the essential ones. The filtered data was then analyzed using the Waikato Environment for Knowledge Analysis (WEKA) which is a Java based Machine Learning toolkit. The collected results were compiled using a charting library, Highcharts.

46.
WHATS YOUR TONGUE SAYING: DEVELOPMENT OF A MOBILE APP FOR TONGUE IMAGE STORAGE AND A DESKTOP GUI TO EXTRACT A DIAGNOSIS FROM AN IMAGAE OF A TONGUE
Courtney B. Driscoll '17
Faculty Sponsor: Peter Yoon

In eastern medicine, particularly acupuncture, the appearance of the tongue is used a diagnostic tool. The problem is that every person may describe the same tongue differently. The solutions is easy, take a picture. The question is then what to do with that picture. In the first part of my project I created a mobile app for image storage. The app allows tongue images to be categorized by patients and then within that categorized by each visit or time that the tongue is used for a diagnosis. The app was created on android studio and uses firebase as a database. In the second part of my project I attempted to eliminate the need to get a diagnosis from an acupuncturist. For this a desktop GUI was created that takes an image as an input. The image is then displayed and a diagnosis is shown in a panel next to the image. The GUI and the program were created using MATLAB. 21 images were used to test the program. Only 4 of the images were able to completely isolate the tongue for further analysis. 11 images were able to isolate part of the tongue. The 4 images that could isolate the tongue were the only 4 images where flash was used. All 4 images did give a correct diagnosis.

47.
ARCHIDNI: YOUR PERSONAL GUIDE & ASSISTANT TO TRAVELS
Maria Dyane '17
Faculty Sponsor: Madalene Spezialetti

Recently, people have been moving from the classic concept of tourism to adopting the new ideology of cultural immersion. Many travel websites are still stuck with the traditional way of

discovering the world: one that focuses on misconceptions and appearance rather than the "REAL" experience. Archidni, which means "guide me" in Arabic, is a website that offers a choice to travelers and guides them to either explore the world the traditional way or explore the world through REAL experience: a Rewarding, Enriching, Adventuresome and Learning Experience. Archidni has five main features: Manage your Travels, Be a Tourist, Experience Culture, Connect with the World and Hear it from the Locals. Archidni allows the user to select their top destinations around the world, suggests travel routes based on the budget and the time the user designates to their trip and finally based on the user passport information (issuing country), Archidni provides information about their visa requirements for each country around the world. Archidni strives to help travelers overcome cultural misconceptions by providing more than traditional travel information. It also connects the user to a local person from either the country or multiple cities in a specific country. This last feature is provided through the Hear it from the Locals feature. The Experience Culture feature allows the user to explore unfamiliar routes and places not usually advertised about the country, culture or specific cities (Local Restaurants, day to day activities of locals, etc.). Archidni is more than a traditional travel guide, catering to a range of users, both those who are looking for traditional sight-seeing experiences or those looking to be immersed in the day-to-day life of locals. Archidni helps preserve culture, correct misconceptions and connect people around the world.

48.
VIRT-U: VIDEOS TO SHAPE THE FUTURE OF COMPUTER SCIENCE EDUCATION
Fabiana Guajardo Garza Barrera '20
Faculty Sponsor: Madalene Spezialetti

With the advent of new teaching technologies, the ways of teaching Computer Science (CS) undergraduate courses have broadened. The use of educational and tutorial videos, one of the new teaching technologies, has increased in CS courses in recent years. Literature on this topic demonstrates that this way of teaching increases student success and is preferred by teachers who have used it. Along with the increased use of digital learning tools, introducing students to entrepreneurial thinking in these courses has also been shown to be beneficial to their career path. This project involves building a website, Virt-U, that is easily adaptable to future change and expansion according to research results. The website includes three types of educational videos for CS undergraduate courses: programming-oriented tutorials, entrepreneurial-thinking skill development videos, and business ethics videos. The videos were created by Dr. Madalene Spezialetti, as part of her research in CS education. In the Fall of 2017, this website will be used in CS undergraduate courses taught by Dr. Spezialetti, allowing the effectiveness of the videos to be tested. Since the website is public, it enables students and faculty outside of Trinity College to use the videos. Further work will include creating new educational videos and expanding the website's user base to provide additional research information.

49.
QUICKMUSIC—ALL-IN-ONE MUSIC TOOL
Yaoqi Guo '17
Faculty Sponsor: Takunari Miyazaki

QuickMusic is a multifunctional music tool for musicians as well as those who play and/or study music. Tools for musicians do exist on smartphones but are rather scattered. This project attempts

to gather most used features among music tools so that users need only one single app for their multiple needs in interacting with music. QuickMusic consists of three features, Metronome, Pitch Detector, and Music Note Player, and a game PitchPerfect. Metronome counts and plays the beats at a given tempo; Pitch Detector tells the frequency of the recorded sound and identifies the music note that the sound corresponds to; Music Note Player allows users to play any notes from a list all 88 music keys on a piano; PitchPerfect first lets users record a short audio and then plays the recorded audio with different speed or with one of the four preset sound modulations. A senior project for Computer Science, QuickMusic is application coded with Swift on XCode and works on iOS devices such as iPhone, iPad, etc.

50.
TRINREPORT: A SECURE AND USER-FRIENDLY INCIDENT REPORTING APP FOR TRINITY COLLEGE'S CAMPUS
Basileal Imana '17
Faculty Sponsor: Ewa Syta

Trinity College has an emergency notification system called TrinAlert that Campus Safety uses to notify all members of the campus community in case of emergency or safety threats. However, there is no convenient system in place that works in the other direction - i.e. a system that allows the campus community to easily report incidents to Campus Safety. While Campus Safety provides channels such as such as emergency blue lights and an online reporting form provided on their web page, these can be inconvenient or even impractical in certain scenarios. Furthermore, the online from is not only inconvenient but also insecure - which is concerning as the form is used by the college's responsible employees to report sensitive information such as those related to sexual assault. The goal of this project is to fix these issues of convenience and security by providing an alternative platform that the campus community can use to reach Campus Safety during emergency and non-emergency incidents. The final outcomes of the project are TrinReport, a secure and user-friendly incident reporting android app, and RDDP, a companion website which will be used by Campus Safety to receive and handle incoming reports.

51.
AESTHETIC FEATURE EXTRACTION AND AN EMOTION GUESSING MACHINE
Peter Jung '17
Faculty Sponsor: Peter Yoon

Images evoke an emotional response in a viewer. The response may be positive or negative, active or passive. The goal of this project was to investigate the relationship between particular aesthetic features of an image and the emotional effect that image has on a viewer. The three aesthetic features chosen to be tested were: the prevalence of horizontal and vertical lines, the brightness, and the amount of bilateral symmetry. Algorithms to extract these features were developed in Java using the computer vision library OpenCV. The algorithms returned numerical outputs corresponding to the percentage of vertical edge pixels, the percentage of horizontal edge pixels, the average brightness, the variance of brightness, and the magnitude of symmetry for a given image. Next, the author's emotional responses to a collection of 300 photographic images were collected and quantified using a model that maps every emotion to a point in arousal/valence coordinate space. Using machine-learning techniques, this response data was used to train a machine to predict the emotional responses to new images based on the output from the algorithms.

Cross-validation testing of this machine with a training set of 270 images and a testing set of 30 images yielded a predictive accuracy of 90%. This suggested a strong correlation between the emotional responses to the set of images and the three aesthetic features. Enlarging the training set of images may increase the accuracy of this model. Finally, the model may be extended by considering additional aesthetic features.

52.
目覚(MEZA) : AN EXPLORATION OF THE MODERN ALARM CLOCK
Adam Krog '17
Faculty Sponsor: Ewa Syta

Studies show that light exposure from screen usage in the morning has negative health impacts. Each morning the average person will wake up and immediately access their smartphone or computer to collect the information they need to start their day. Meza consolidates all of this information and delivers it to the user via Text-To-Speech, allowing the user to avoid screen usage. Meza features News, Weather, and "SmartSleep" sleep-tracking functionality in the form of a bedside alarm clock built around a Raspberry Pi 3 that is connected to an embedded touchscreen.

53.
ELECTRONIC MUSIC GENERATION WITH MAGENTA
Bingqing Li '17
Faculty Sponsor: Takunari Miyazaki

The project is an investigation of the possibility of artificial intelligence capable of composing music. In particular, a recurrent neural network is trained on MIDI files of electronic music. The recurrent neural network has two layers and each layer consists of 64 Long Short-Term Memory (LSTM) cells with attention. Attention allows the model to more easily access past information without having to store that information in the RNN cell's state. MIDI files used for training is obtained from the Million Song Dataset and the Lakh MIDI Dataset. The trained model is able to generate melodies based on given inputs. The model achieved 84% accuracy on the training data. This result is limited by the amount of training data and computing power that was available during the time of the project. Based on the result, it can be concluded that with enough training data and computing power, a model that is able to generate music indifferentiable from a human composer/musician is attainable. However, the question regarding aesthetic value of the generated music and the nature of the generation process remains, but such questions belong to the field of philosophy, not computer science. An interactive demo was also built with the trained model, using which a human agent is able to feed input into the model with a MIDI keyboard and get realtime feedback from the model.

54.
EVALUATING THE LEARNABILITY OF K-MEANS CLUSTERING
Yuxuan Li '17
Faculty Sponsor: Takunari Miyazaki

Recent years have witnessed increased interest in research and the application of machine learning, where models update themselves without being explicitly instructed. Machine learning models are

widely used in tasks such as email spam detection, recommender systems, and speech translation. Promising results were shown even for complicated tasks such as image recognition and video recognition. However, the credit is largely due to supervised learning, where models are trained with known labels. What happens when models are trained without any prior knowledge? This is known as unsupervised learning, which does not allow for the tuning of the representation by consulting known labels. The current project investigated this issue of learnability in a pure unsupervised learning setting. In particular, we focused on *k*-means clustering as a representative algorithm. *k*-means groups data instances into k clusters so that each data instance falls into the cluster with the nearest centroid based on the Euclidean distances across the attributes. Using datasets from the UCI machine learning repository and Python's machine learning library Scikit-learn, *k*-means' performances on a variety of datasets (n=40) were evaluated with Adjusted Rand Index (ARI). ARI scores range from -1 to 1, with 1 indicating identical clustering assignments and 0 indicating randomly matched clustering assignments. We found that nearly half of the datasets resulted in an ARI score around 0. For datasets whose scores were above 0, *k*-means did not generate the optimal performance at the optimal k, i.e., the ground-truth number of clusters in each dataset. Rather, the optimal performance scattered in k values deviating from the optimal k. These results suggested that the reasonable partition from *k*-means clustering does not adhere to the desirable outcome, revealing the inherent difficulty of pure unsupervised learning.

55.
J3DGE: AN EDUCATIONAL 3D GAME ENGINE WRITTEN IN JAVA
Minghui Liu '17
Faculty Sponsor: Peter Yoon

J3dge is an educational 3D game engine written in the Java programming language. J3dge is created due to the lack of good learning materials on game engines, and is built to be a learning material for students interested in the topic. The goal of J3dge is to help students learn the internals of a game engine by studying its source code. While a lot of other open source game engines exist, they are not ideal for beginners to learn because of their complexity and code readability issue. J3dge is designed to be simple and readable: It contains only a core set of features and its source code is easy to read and self-explanatory. The Java programming language was chosen to be J3dge's implementation language because of its expressiveness and its popularity among computer science students.

J3dge supports multiple windows, keyboard and mouse input, mesh loading, texture, material, realistic lighting, resource management and various other features essential to a game engine. A game demo was created to demonstrate the features of J3dge and to prove that it can be used for game production. The source code is organized logically into 36 classes controlled to stay below 4000 lines and can be read through quickly by any students with some graphics programming experience. J3dge is open source and free to everyone.

56.
OFF THE GRID (OT): A NATIVE iOS 9.3+ APPLICATION WITH END-TO-END ENCRYPTED GROUP AND PRIVATE CHAT
Soham Madnani '18
Faculty Sponsor: Ewa Syta

OT is an iOS application written in Objective C and Swift that lets users have secure conversations. The app has multiple message delivery options like one-to-one chat, one-to-many chat and group messaging. The users on the app are authenticated using their email accounts and verified mobile phone numbers. The messages sent over any channel on OT are asymmetrically encrypted using the recipients public key stored on a server and decrypted using the users private key stored locally on the iPhone. The app also lets users truly delete messages (removing the message from the database) allowing users deniability on their side and adding security to conversations.

57.
FINDMYRESTRO
Kishwor Pokharel '17
Faculty Sponsor: Takunari Miyazaki

Nepal has many traditional restaurants that go undiscovered just because they do not have a trace online. Most of these restaurants end up getting closed due to a lack of exposure to the public. This leads them to be surpassed by urban restaurants in a competitive economy. This web application will try to bridge the gap between these traditional restaurants and the people of Nepal. It will be a platform for these traditional restaurants to advertise themselves without any cost. Not only is this app meant to serve as a platform for the restaurants, but it will also provide the users with relevant information about the restaurants listed. The users will be able to rate and review the restaurants they visit in the web application. Along with this, FindMyRestro will also recommend restaurants to its users in accordance with their past likes. It has been difficult to obtain data from Nepal right now due to its geographical distance. Therefore, for the testing phase, FindMyRestro will use the restaurants around Trinity College. The app uses firebase for the database, storage and deployment because of it cost-free service for lighter web applications.

58.
NOTEWORTHY: A WEARABLE DEVICE APPROACH TO PERFECTING HUMAN'S AUDITORY MEMORY
Phongpol Punyagupta '18
Faculty Sponsor: Ewa Syta

Our auditory memory (remembering what we hear) is highly unreliable in both the short-term and long-term, yet a significant amount of our daily informational inputs is presented to us verbally through conversations.

Current solutions require users' explicit awareness, consisting of archaic pen-to-paper note-taking and audio recording on mobile phones; both of which intrudes the quality of the conversation. Noteworthy's objective is to provide an automated solution for perfectly remembering conversations specific to individual user's preference on what should be remembered, and storing these conversations in an easily recallable format. Noteworthy accomplishes these goals by

creating a wearable device that utilizes a pulse sensor and Bluetooth low energy technology to send Inter-beat interval to a companion mobile application. The mobile application analyzes the inter-beat interval to compute the running Heart Rate Variability (HRV) of the user and auto-detect stress based on a change detection in the user's HRV trend. Upon stress detection, the mobile application triggers an audio recording and subsequent speech-to-text translation which are both stored in a user-friendly interface. The outcome of this project is a wearable device and mobile application that work in tandem to provide end users with perfect auditory memory.

59.
LITERARY TEACHING ASSISTANT
Harrison Quarls '17
Faculty Sponsor: Peter Yoon

One of the largest issues teachers are facing is to get their students to read. Students claim there is not enough time in the day to pick up a book and read their assigned text, leading to them being unprepared for a class discussion or lecture. Hard copy books are expensive in today's economy, leading more and more people to digital copies. The Literary Teaching Assistant resolves these issues by bringing assigned readings into the digital world. The application streamlines the reading and annotation process, allowing students to create annotations without fear of margin space. Long gone are the days of buying a pack of multi-colored highlighters. Students have the option to choose any color they wish and highlight parts of text. Students can save key locations in the text, and instantly move to that location with a click. There is a simplified dictionary and pronunciation feature, allowing students to quickly look up a term without having to leave the software. Students can place images in the text, aiding in the visualization of the text. All data is stored on a local database and created on a windows platform using primarily C# coding language, as well as XML and SQL. The application was created in consultation with high school educators to target English classes, however, this software can be used for other classes as well. Future development of this project will be directed towards the interface of the application and final release of the software to students.

60.
MEASURING IMPROVEMENTS TO GRÖBNER BASIS COMPUTATION WITH S-POLYNOMIALS
John Wallace '17
Faculty Sponsor: Takunari Miyazaki

Gröbner bases are finite sets of polynomials satisfying a set of properties that make them widely applicable in a variety of fields including computational mathematics, computer algebra, and mathematical modeling. The problem of computing Gröbner bases is, in general, a very difficult problem and one of the most frequently cited examples of a problem lying in the double-exponential complexity class. Virtually all of the algorithms designed for improving the efficiency of Gröbner basis computation have sought to do so by reducing the number of S-polynomials computed throughout computation. An S-polynomial is a combination of two polynomials critical to computing a Gröbner basis; the computation of which has been widely identified as the "computational bottleneck" of the problem. Despite this, algorithms are mostly compared by timing their performance on a number of problem instances.

In this project, the number of S-polynomials computed was used to compare the efficiency of Gröbner basis algorithms, as opposed to timing the algorithms on like inputs. This approach was taken in order to isolate the most expensive aspect of Gröbner basis computation from other algorithmic operations that are less fundamental to the problem (but still captured when measuring performance with time). To accomplish this comparison, we implemented five Gröbner basis algorithms in the computer algebra system SINGULAR and recorded the number of S-polynomials computed as well as the number of S-polynomials avoided. The results show, quite decidedly, that two of these algorithms are superior to the others. Interestingly, S-polynomial comparisons fail to distinguish which of these algorithms is more efficient, due in part to one algorithm being very inefficient with respect to time. Moreover, comparing these two algorithms gave rise to two distinct ways of using S-polynomials to measure algorithmic efficiency.

61.
DREAM ISLAND: A 2D VIDEO GAME ADVENTURE
Ian Weist '17
Faculty Sponsor: Madalene Spezialetti

Dream Island is a 2D video game for people who have been through grief by telling a story of a child who is experiencing the grieving process after the death of his sister. The game's story is told through four thematically different parts of the game that each depict a different part of Kubler Ross's stages of grief, isolation, anger, bargaining, depression and the game's character ending in acceptance. Each part introduces a new way for the player to defend themselves and attack the enemies. The games enemies represent the bad state of mind one is in when grieving and need to be overcome. The game was developed for the PC using the Unity engine with the help of JPixel and Tiled to create the visual elements to invoke an engaging, enjoyable and emotional experience.

62.
USMACROTRENDS: A GEOSPATIAL ANALYSIS OF MACROECONOMIC TRENDS
Nicholas Wray '17
Faculty Sponsor: Madalene Spezialetti

This project is a web-based interactive map display of macroeconomic indicators such as labor, capital, unemployment, and gross product. By examining the change in these terms over time, the map is colored as a heatmap and the elements can be compared against one another. Utilizing the graph database Neo4j, the data is represented in three node types, namely Counties, States, and Metropolitan Areas, and each has their own set of visualizations. For example, it is very easy to demonstrate which metropolitan area was hit the hardest by the Great Recession. In the front-end Javascript provides quick map updates via display library D3, and when combined with the Cypher query to Neo4j, the map updates almost instantly. Front-end packages such as Bootstrap were utilized to make the design minimalist and appealing. The result is a dynamic, aesthetically pleasing map display that will be useful and interesting to the casual user and economist alike.

ENGINEERING

63.
DESIGN OF A WIRELESS ELECTRONIC STETHOSCOPE
Victoria A. Baez '17, Courtney B. Driscoll '17, Monica C. Mhina '17
Faculty Sponsors: Taikang Ning, Deborah Fixel

The goal of our project is to use modern technology to improve a traditional stethoscope. The traditional stethoscope consists of a drum, tubing, and earpieces. The sound signal can be distorted as it travels to the earpieces through the tube, and a proper diagnosis, specifically for the presences of murmurs, relies on the subjectivity of human hearing. Our design, the wireless electronic stethoscope, aimed to collect a signal directly after the bell and wirelessly transmit it to a display. The visual display of a sound signal eliminates the subjectivity of human hearing. In our project, we updated the design of the traditional stethoscope by removing the earpieces and tubing and replacing it with a microphone. The signal from this microphone was then amplified to a high enough voltage to be read by a microprocessor. The signal was also passed through a filter before it was fed into the microprocessor. The microprocessor was used to convert the signal from analogue to digital and then display the signal on the LCD. Wireless transmission protocol then allow the signal to be sent via Bluetooth to a host computer or mobile device. Ultimately, redesigning the traditional stethoscope using modern technology will allow for a visual representation of the heart sound, which eliminates the subjectivity caused by using the traditional stethoscope.

64.
THE MUSCULAR RECOVERY UNIT
Griffin Bossard '17, Ryan Reuther '17, John Lipari '17
Faculty Sponsor: Taikang Ning

The Muscular Recovery Unit, or MRU, utilizes an automatic control system to provide heat and cold therapy to patients. Many options for heat and cold therapies are either expensive, require troublesome setup procedures, or do not provide the patient with consistently optimal temperatures. The goal of this project remained to create a cost-effective therapeutic device capable of providing the user with optimal heat or cold therapy sessions. Specifically, the objective was to use a control system to maintain the temperature in a therapeutic pad using water flow for a 20-minute session; the heat therapy session was to be kept at 105 degrees Fahrenheit, and the cold therapy session was to be kept at 35 degrees Fahrenheit with an uncertainty of 5 degrees for each temperature. To accomplish these objectives, the system was designed to include a cold and hot water reservoir that connected to a 3D printed water-mixing chamber via copper piping. A solenoid valve was placed in between each of the two reservoirs to control the flow of these hot and cold water sources to the mixer. The mixing chamber served as a safety precaution to ensure that the water was the proper temperature and could not burn the user during a heating session. The mixing chamber then connected to another solenoid valve which controlled the flow of water to the therapeutic pad. From the pad, water flowed to the last solenoid valve to exit the system. Water inside the mixing chamber and in the pad was monitored by two separate DS18B20 digital temperature sensors. The pad's temperature was then displayed to the user via LCD monitor. All the electronic components of the system were controlled using an Arduino Uno microcontroller.

65.
SUSTAINABLE GREENHOUSE WITH COMPOST TUMBLER
Sydney Doolittle '17, Jordan Politz '17
Faculty Sponsor: Michael Kapralos

The purpose of this project is to design and build a greenhouse using knowledge from undergraduate course requirements and by leveraging connections made with other campus departments. The criteria for the greenhouse include low cost and ability to sustain plant life during New England winter conditions, which requires maintaining a minimum internal temperature of 70ºF (21ºC) with external temperatures reaching as low as 32ºF (0ºC) (Wiley). There are two overall categories of concern: putting generating energy in and reducing energy loss. The input of energy include methods of heat generated by the decomposition of compost and solar radiation. The prevention of energy loss include analyzing materials for properties affecting conduction and radiation through the walls, as well as convection from the surface of the structure. The final variable is the number of air exchanges that occur within a fixed amount of time, which is a factor of how well the greenhouse is built. This property is important because not only does it affect the quality of air within the greenhouse, but also the exchange of heat with external air, which is significantly cooler than the internal temperature.

Works Cited:
Wiley, Deb. "Start Your Garden Right: Know When to Plant Your Vegetables." Better Homes and Gardens. N.p., 15 Mar. 2017. Web.

66.
BI-X: THE DESIGN AND CONSTRUCTION OF A BIOMECHANICAL EXOSKELETAL ARM
Graham Dworkin '17, Phillip Winser '17
Faculty Sponsor: Joseph Palladino

A biomechanical exoskeletal arm (Bi-X) was designed in order to increase the efficiency of manual laborers in the workplace. The device assists the user in an "arm curl" motion, ultimately increasing the user's strength by 50 lbs. The exoskeletal arm was designed to be safe, powerful, portable, and easy to operate. The Bi-X mirrors the motion of a user's bicep and tricep muscle groups using a hydraulic cylinder to actuate an artificial *radius*/*ulna* with respect to an artificial *humerus*. The device is required to lift 50 lbs through 110º of motion within 2 seconds, and operate on a single battery for a minimum of 30 minutes. Preliminary tests on the prototype show that the current design, while able to lift 50 lbs through 110º of motion, is unable to achieve this in less than 2 seconds. This is a failure of the hydraulic system, which could be rectified in future design iterations.

67.
RESPIRATION MONITORING AND APNEA DETECTION USING FUZZY LOGIC
Ahmed Eldmerdash '20
Faculty Sponsor: Taikang Ning

Apnea is a common sleep disorder with detrimental effects on health, performance and safety. This underlying research uses modern computing technologies to assist the diagnosis of sleep apnea.

The method is based on several signal processing algorithms that can extract useful respiration features such as signal energy, respiration rate, and respiration waveform slope. These features are examined, and respiration signals are categorized into normal breathing, apnea, and breathing episodes combined with body motion artifacts, which are caused by body movement. Fuzzy logic is adopted in the decision making process. The fuzzy logic based respiration monitoring and apnea detection approach provides accurate respiration rate estimation and 100% detection of apnea episodes. Its performance has been validated by testing on the public MIT physiology database and the respiration measurements collected in our lab.

68.
UNIVERSAL WIRELESS CHARGING DEVICE
Affeeq Ismail '17
Faculty Sponsor: J. Harry Blaise

This project's goal was to design a wireless charging system that uses the wireless power system to transfer energy between the transmitter circuit and receiver circuit via an electromagnetic field. The wireless charging system was broken down into two different systems, the transmitter circuit and the receiver circuit. The transmitter circuit was a Colpitts Oscillator, which was composed of an amplifier and a resonant tank circuit. The receiver circuit was composed of a resonant tank circuit and a rectifier. The main objective of this project was to determine the possible efficiency and distance of the charging system by testing different aspects of the coil. The coil was the system's primary tool to transfer energy between the transmitter and receiver circuit. Coils purchased from a manufacturer and coils built by hand were tested and compared. A flat spiral coil made of Litz wire with a ferrite core was able to maximize charging distance and had greater efficiency than other coils.

69.
OPTIMIZATION OF DIGITAL LOGIC FUNCTIONS
Brendan Lynch '20, Matt Bicknese '20
Faculty Sponsor: Michael Kapralos

At the most basic level of computing are gates, components of a motherboard which take inputs and give outputs such that a desired result is achieved, and eventually presented to the user in some sort of output medium, like a monitor, or file. The design of these gates can be optimized such that computing runtime and memory usage is minimized. This optimization is performed by the elimination of redundant gates, which give the same outputs as a single gate. One method of reducing these redundant gates is to determine candidates for removal. To identify these candidates Gray Codes are generated, using a Python implementation of a common recursive algorithm. The Gray Codes will be input into another script using trees to perform optimization given a set of outputs for a given design. This tree-based optimization is still in progress. When completed, comparisons between the results of our own work to other publicly available solutions will be made. Because digital logic optimizations are heavily resource-intensive, even minor improvements in performance can result in significant improvements in runtime and memory usage.

70.
PULSATILE FLOW PUMP
Andrew McCahill '17, Alec Bunge '17
Faculty Sponsor: Joseph Palladino

The goal of this Capstone Senior Engineering Design project is to create a pump capable of mimicking the human heart's pulsatile flow. The pumping chamber is attached to a rubber diaphragm; the pulsatile motion of this diaphragm causes a differential in pressure, pulling water into the chamber as it expands and pushing it out as the diaphragm contracts. A stepper motor programmed using pulse width modulation drives the motion of the diaphragm. This allows for precise rotation speeds operating the pump for a range of fifty to two hundred beats per minute. To measure the pump's pressure differential a pressure transducer is located at what would be the aortic valve of the pump. To accurately mimic the flow of the heart, the diastolic base pressure of the flow should be measured at 70 mmHg with a pulse pressure raising the systolic pressure to 110 mm Hg. The pump achieves this pressure differential by adding compressed air into the pumping chamber then changing its volume proportional to the desired pressure change. This project allows users to create a pulsatile flow through a biomaterial for cardiovascular testing.

71.
DESIGN OF A PORTABLE TEST FIXTURE FOR THE MEDTRONIC SIGNIA SURGICAL STAPLER
Chris Mulhern '17, Hieu (Hugh) Nguyen '17, Tristan Peirce '17, Robert (Bobby) Tella '17
Faculty Sponsor: Joseph Palladino, Medtronic Minimally Invasive Therapies Group

Surgical staplers are widely used in laparoscopic surgeries to clamp, staple, and cut tissue. The goal of this project is to create a test fixture for the new generation of the Medtronic Signia surgical stapler. The device must allow the *Signia* Power Handle to perform a clamp test, where the device must exert a force on the firing rod within a predetermined range depending on the intended final load, as well as a firing test, where the device provides a unit-step like load profile to the firing rod which varies depending on which firing speed is being tested. The device must also be safe to use, easy to use, able to survive 100,000 uses, and be easily transportable. A Pugh matrix was constructed to rank three design concepts. The final design was based on a hydraulic piston coupled with parallel flow paths that are controlled by a series of valves. The system was filled with hydraulic oil. By changing which shut-off valves are open or closed and the opening angles of adjustment valves, pressure drop within the system can be controlled, and therefore the resistive load on the firing rod can also be controlled. Computational fluid dynamic (CFD) simulations were run to obtain a proof of concept model and estimate design parameters. Relationships between valve opening angles and pressure drops were determined experimentally. Preliminary results suggest valve opening angles that would create the desired resistive loads.

72.
THE SELF=BALANCING WAITER ROBOT
Hung Nguyen '17, Yuwei Wang '17
Faculty Sponsor: J. Harry Blaise

Motivated by the annual RoboWaiter competition held by Trinity College Engineering Department, this project aims to create a device similar to that of an automated drink carrier, but

with a major change in design: the robot is self-balancing on two wheels as long as it is powered. With a compact size and good maneuverability, this self-balancing robot is intended for narrow aisles on modes of public transportation such as airplanes, trains and buses. In addition, this robot is very inexpensive and easy to assemble. Most of our designs lie in the programming to achieve self-balance while standing still or traveling at desired speed. By designing and implementing a control system on MATLAB and Simulink, we were able to achieve the desired self-balance. To remotely control the robot, we employ RC transmitter and receiver, integrating these with our self-balance program.

73.
SHOCK TUBES AND GAS DYNAMICS
Donovan Palmer '20, Farhan Rozaidi '20, Alex Sinson '20
Faculty Sponsor: John D. Mertens

Shock tubes are long cylindrical tubes with two sections—one with high pressure, and one with low pressure—separated by a barrier, known as a diaphragm. Using shock tubes, one is able to study reactions at high temperatures and pressures in a controlled environment, allowing one to obtain data on the reaction rate coefficient—known as variable k—of a specific reaction. Data from previous experiments is uploaded to computer programs such as MatLab, where the data is used to run simulated experiments and output graphs illustrating the changes in concentrations, temperature, and pressure of a given reaction. The complete database was modified to contain only the reactions species involved in the reaction of nitrous oxide, N_2O, and hydrogen, H_2. This specific mechanism was used to analyze how various temperatures, concentrations, and pressures affect the combustion. Similar work can be done for other fuels. Efforts were begun to perform studies of Nitromethane and Methane. One application of this research is to get to a point where this database contains every possible reaction, allowing researchers to simulate any reaction without physically conducting an experiment. This program reduces the time required to determine the outcome of a reaction, as the alternative is to run the reaction in a shock tube, which requires significant resources. Studying shock tube reactions can provide deeper insight of environmental effects of combustion as well as a better understanding of fuel efficiency and combustion in car engines.

74.
REMOVING CROSS-TALK FROM DEEP BRAIN HIPPOCAMPAL EEG IN ADOLESCENT RATS
Catherine Poirier '17, Jessica Voight '17
Faculty Sponsors: Taikang Ning, J. Harry Blaise

Rapid eye movement (REM) sleep data from adolescent rats was examined using linearly independent data collected simultaneously from the CA1 and DG regions of the hippocampus. Deep-brain electrodes were inserted during stereotaxic surgery and sleep from freely behaving rats (n = 7, age = 28-32 days) was recorded. An experimental and analytical methodology was designed to remove cross-talk induced noise between the two regions; this included calculating the level of coherence among the two signals using Magnitude -Squared Coherence (MSC) and removing the linear dependencies using Independent Component Analysis (ICA). Results indicate that our processes successfully removed cross-talk with statistical significance from sample data sets

(p<0.0001 for all n). Results from the collected EEG data sets were inconclusive and research will be continued with modification to the recording parameters.

75.
HYDROELECTRIC WAVE ENERGY SYSTEM
Randi Whitham '17, Tom Costigan '17, Christopher Cilliers '17, Chris Gallic '17
Faculty Sponsors: John D. Mertens, J. Harry Blaise

As the world turns towards renewable energies for future energy supplies, the question is which type of renewable energy will be the most dependable. The ocean is an extraordinary source of untapped energy including waves, currents, and temperature differences. This project is designed to harnesses the energy naturally present in ocean surface waves via a buoy and a spring loaded pump. Through non-dimensional analysis, a prototype spring loaded pump was developed and tested in a wave simulation tank. Experimental testing revealed that the spring loaded pump successfully elevated water at a rate of 0.09 gallons/min, proving the ability of the system to convert wave energy into stored potential energy. This stored potential energy would then theoretically be connected to a hydroelectric turbine in order to convert it into marketable electrical energy. The efficiency of the prototype pump was determined to be 19%, due to limitations in the manufacturing of the plunger within the pump. The full-scale system is designed so that an array of 20 buoy-pump systems will all pump water into a central, land based storage tank elevated to 75.5 feet above sea level. This storage tank will release the elevated water at 16.5 gal/s to a turbine with 90% efficiency, to produce 12.2 kilowatts during peak usage hours.

ENVIRONMENTAL SCIENCE

76.
THE EFFECTS OF CLEAR-CUTTING ON SOIL ALUMINUM AND CALCIUM LEVELS IN THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE AND MAINE
Jack Agosta '17, Kevin Oleskewicz '19
Faculty Sponsors: Jonathan Gourley, Andy Coulter (U.S. Forestry Service)

Clear-cutting is and has been a highly efficient and profitable method of harvesting timber for well over a century in the White Mountain region of New Hampshire. However, it can have serious negative effects on the surrounding forest ecosystem. One of these effects is the significant alteration of soil nutrient concentrations due to increased soil nutrient leaching and runoff. This study focuses on measuring changes, if any, in soil aluminum and calcium levels. Aluminum is a key nutrient for plant growth and calcium is important for root, leaf and flower stability and health. Working with the USDA Forest Service, soil samples were taken on transect lines at multiple different clear-cut study sites in the White Mountain National Forest of New Hampshire. Samples were taken from the O and B- soil horizons at these sites: including samples from Douglas Brook -- located in the heart of the White Mountain National Forest – which will be the area of focus in this study. The samples were processed using acid digestion before being run through the Inductively Coupled Plasma-Optic Emission Spectrometer (ICP-OES) where aluminum and calcium concentrations were measured.

The sites were sampled both prior-to and post clear-cutting (at both 1 and 2-year intervals) to measure and compare baseline nutrient concentrations with post clear-cut nutrient concentrations

under the hypothesis that measurable effects, if any, may not manifest until several months after logging operations have concluded.

77.
DETERMINING A METHOD FOR METHYL MERCURY EXTRACTION IN FOREST SOILS
Cassia Armstrong '18, Emily Kealey '20
Faculty Sponsor: Jonathan R. Gourley

Though much research has been conducted on methyl mercury (MeHg) concentrations in aquatic sediments, little is known about methylation of mercury at higher elevations and under differing environmental conditions in terrestrial environments. With the objective of furthering understanding of mercury cycles in terrestrial environments, soil samples have been collected along several hiking trails as well as large areas of land that have been clear-cut in the White Mountains National Forest. Because the Northeast United States is a hotbed for atmospheric mercury deposition, analyzing how total mercury and MeHg differ in areas of high or low rainfall, with or without the presence of nearby streams may produce interesting results and implications for the bioaccumulation of MeHg in local wildlife. Before these questions can be explored, a viable method for MeHg extraction that is within the resources provided at Trinity College must first be determined and trialed. Combining various MeHg soil extraction methods from previous studies has thus far provided relatively consistent results. The method involves an acid digestion of soil samples using a solution of sulfuric acid, KBr, and $CuSO_4$, extracting the MeHg into a toluene layer, and then extracting the MeHg further into a solution of L-Cysteine and sodium acetate for analysis with the DMA-80. Using a standard with an MeHg concentration of 75 ± 4 ppb and total Hg concentration of 132 ± 3 ppm, this combined method has produced an average MeHg concentration of 126.1239 ± 6.5739 ppb. Though this result is higher than the MeHg listed by the reference material, it is within the same order of magnitude, with the possibility of contamination by the very large total Hg concentration, the causes of which will be explored further. Though further experimentation to improve the accuracy and efficiency of this method are in the immediate future, it is expected that refinement of this method will allow it to soon become an accessible tool for expanding the current literature on the terrestrial cycling of mercury.

78.
THE INVASIVORISM MOVEMENT: CONTROL OF THE INVASIVE SHRUB JAPANESE BARBERRY (*BERBERIS THUNBERGII*) THROUGH HUMAN CONSUMPTION
Blair E. Frantz '17
Faculty Sponsor: Krista Ehlert

Invasions of native communities by exotic plants are a growing concern. Nearly all ecosystems in North America have been affected by invasive species. Native to Japan, Japanese barberry (*Berberis thunbergii*) was introduced to the U.S. in 1875 as an ornamental shrub. Since its introduction, Japanese barberry has spread throughout the northeastern U.S., and is found in all New England states. The abundant use of Japanese barberry as a landscape shrub has resulted in its spread from disturbed forest edges and open fields to the forest matrix. Japanese barberry is a threat to native species because it shades out tree saplings and in areas where Japanese barberry is well established it can displace native herbaceous and woody plants. Thus, Japanese barberry is

illegal for sale in Canada, and is banned in some New England areas. This study focused on the invasivore movement, which is a means of eradication of invasive species through human consumption. Invasivores are defined as people whom incorporate invasive species into their diets. They are a growing group that believes eating unwanted invasive species is one way to eradicate them from the environment. Benefits of incorporating invasive plants into our diet include accessibility, nutrition, freshness, taste appeal, and cost effectiveness. Moreover, it has been suggested that a shift in eating patterns to invasive species could potentially relieve the burden on some farmed meats. To further investigate invasivorism, field work was conducted at Owen-Mortimer, owned by the Simsbury Land Trust in Simsbury, Connecticut. Random sampling of Japanese barberry was conducted using transects to observe and collect the fruit berries from this infamous New England invasive shrub. Following collection of fruit over a one-week period, berries were used to produce jam using a Japanese barberry jam recipe from the literature. In addition to the health benefits associated with the Japanese barberry, the objective of this study is to preserve Simsbury's natural beauty and native environment through the movement known as invasivorism.

79.

INVESTIGATING THE MAGNETIC SUSCEPTIBILITY OF PALEOSOL MIDDLETOWN SOIL

George Kapanadze '20
Faculty Sponsor: Christoph Geiss

The susceptibility of soil was determined in order to deduce how soil formation affected magnetic mineralogy and the clay minerals of old paleosols. Soil samples were obtained along the bank of the CT river, south of Middletown from a Pleistocene paleosol of unknown age. The samples were dried and packed into boxes for magnetic analyses as well as being prepared for XRD (X-Ray Diffraction) clay analysis. Gravel, organic carbon, inorganic carbonates and iron oxides were all removed using similar methods that involved both buffer solutions and centrifugation. The sand fraction was separated through sieving and the clay fraction was differentiated from the silt fraction through the accelerated settling of particles in a centrifuge. The basic concentrations of magnetic minerals were estimated through magnetic susceptibility, which was measured using a Kappabridge KLY4 susceptibility meter, ARM (Anhysteretic remanent magnetization – a magnetic grain size proxy) and a JR6 spinner magnetometer. Our measurements yielded high magnetic susceptibility and ARM values for the paleosol horizon. Thus, it can be considered that magnetic mineralogy does affect soil formation and therefore can be used to quantify the degree of pedogenesis (soil formation). This study will be conducted by focusing on soil proxies to outline the characteristics of various horizons in relation to one another.

80.

THE EFFECTS OF CLEAR CUTTING ON SOILS IN THE WHITE MOUNTAINS NATIONAL FOREST, NH

Stephen Leo '17, Lucian Cascino '18, Caitlyn Linehan '19
Faculty Sponsor: Jonathan R. Gourley

A positive relationship has been found in past studies when looking at the percent of organic mater present in soils and the concentration of mercury. It has been previously studied that mercury movement can follow organic matter in forest areas affected by clear cutting. The study site that

is being analyzed today was one of three. They were sections of forests in the White Mountains National Forest (New Hampshire) that have been clear-cut in 2014. The focus of this research project involved finishing the last sampling of the Douglas Brook Site for analysis of both mercury concentrations and organic matter. This presentation focuses on the final sampling of Douglas Brook that took place in fall of 2016. The soil samples being analyzed were taken from the location before the clear-cutting and then 2 years after. The samples are gathered by horizon (O,B) and brought back to Trinity College were they were freeze dried and analyzed using a Milestone Direct Mercury Analyzer (DMA) and furnace for loss on ignition. Previous analysis has shown an overall downward trend from pre-cut to 2015 for both percent organic matter and total mercury concentration from the samples from the Douglas Brook site. The 2016 data is being compiled now however it is hypothesized that there will be an upward trend for both. This study is comparing results over time to see the affects of clear-cutting on soils to see how it impacts organic matter and mercury levels. The results of the study will be used by the USDA Forest Service to understand how clear-cutting will effect soils.

81.
THE ROLE OF HORSES AS POTENTIAL VECTORS OF INVASIVE PLANTS
Corinne Macaulay '18
Faculty Sponsor: Krista Ehlert

The United States has experienced an increase in recreational equestrian riding in the past decades with many different variations of the sport from competitive to therapeutic. With this renewed enthusiasm in equestrian riding, there is speculation that horses are able to transport plant seeds from one location to another. Therefore, horses pose a threat to seed dispersal of invasive plants, which can negatively impact pastures and hay meadows, and thus, equine forage sources. The purpose of this research project was to survey Intercollegiate Horseshow Association (IHSA) student riders about their perceptions and knowledge about invasive plants. Riders were surveyed from nine colleges throughout Connecticut and were mainly female and Caucasian, between the ages of 19 to 22. A needs assessment survey of 10 questions was administered to 47 anonymous participants on 25 February 2017. Survey questions were categorized into three separate groups: Demographics, Seed Dispersal, and Attitudes toward Conservation. In general, the majority of survey participants ride a minimum of once a week, for 30-60 minutes at a canter (10-17 mph) during each ride. Trail riding is often a recreational opportunity that riders seek. While a majority of the participants ride at barns with access to these trails, horses are only permitted on the trails with owner consent – therefore many student riders cannot use the trails. Despite this, the majority of participants feels that, although they are not familiar with environmental science issues, invasive plants should still be a concern for all equestrians. Overall, survey results suggest that more outreach and education of riders on conservation issues, specifically as they relate to invasive plants that pose threats to the surrounding native plant community, is needed.

82.
ACCUMULATION OF TRACE METALS IN URBAN POND ECOSYSTEMS
Hazel Robertson '19, Torrey Hill '19, Shane McLaughlin '19, Colbie Cook '19,
Lupita Barajas '17
Faculty Sponsor: Amber Pitt

Trace metals are elements such as copper, iron, or lead, all of which can be toxic to organisms when present in high concentrations, although they are typically found at minimal levels in the environment. These metals can be introduced into the environment through emissions from fuel combustion, industrial materials, agriculture, and much more. High concentrations of trace metals in wetland environments can adversely affect both wildlife and overall ecosystem health. The EPA has established criteria based on scientific analysis of which trace metal concentrations are ideal for the cultivation of aquatic life and which concentrations pose significant risks. The element selenium specifically is one such trace metal that can be nutritionally essential to wildlife in small doses but extremely toxic in large concentrations. Therefore, determining the concentration of trace metals, such as arsenic, copper, selenium, and lead in local ponds can help determine the relative threat these contaminants pose to wildlife and the broader ecosystem. Our objective was to determine the concentration of trace metals in ponds within the greater Hartford, Connecticut metropolitan area. We collected sediment samples from ten urban ponds in and around Hartford. For each pond sediment sample, we used an Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES) to determine the concentration of seven different metals for which concentration criteria have been established for limiting impacts to aquatic ecosystems. Ponds contained high concentrations of trace metals with known toxicological effects. Concentrations of arsenic, cadmium, copper, iron, and lead surpassed the recommended maximum limits established for those substances in aquatic ecosystems. These results indicate that pond ecosystems in the greater Hartford area are heavily impacted by trace metal contaminants which pose a risk to wildlife and ecosystem health.

83.
THE EFFECT OF MERCURY POLLUTION ON TERRESTRIAL VASCULAR PLANTS
Joseph R. Ruggiero '19
Faculty Sponsor: Jonathan R. Gourley

The presence of heavy metals such a mercury can have a significant impact on quality of soil and plant life. Previous studies have concluded the accumulation of mercury in various parts of terrestrial vascular plants will result in reduced growth and impaired metabolism. The goal of this study will be to observe and trace the accumulation of mercury within different sections of vascular plants. *Bean plants* will be grown for approximately 6-8 weeks until maturity. Mature plants will be subjected to different concentrations of mercury over multiple trials for a varying amount of days and weeks before cultivating and dividing into three parts: the root, stem and the leaves. Previous analysis has indicated the highest concentration of Hg is measured in the roots, and the distribution of Hg was positively correlated to the root size. However, other studies have found that the distribution of Hg throughout the plant is dependent on the species observed. Therefore, it is hypothesized that the bean plants cultivated will show the highest Hg concentrations in the roots due to their fine roots and rapid metabolism. The results of this study will be applied to summer research, which will investigate the uptake of Hg by higher order terrestrial species. This can then be applied to other projects correlated to mercury distribution among the Environmental Science Program

HEALTH FELLOWS

84.
ASSESSING RISK BEHAVIOR AND PROVIDING HEALTH EDUCATION TO URBAN YOUTH
Hannah Adams '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Garry Lapidus PA-C, MPH Director Injury Prevention Center, Assoc Prof., Pediatric & Public Health UCONN School of Medicine

The Youth Risk Behavior Survey (YRBS) was created by the Centers for Disease Control and Prevention to monitor youth risk behaviors in private and public school students across America. Youth risk behaviors are those that increase the chance of injury, illness, and death in young people and arise from things such as sexual encounters, tobacco, alcohol, other substance use, diet and physical activity. Many major cities in the United States participate in this survey however Hartford, CT does not. Capitol Squash is an afterschool program that enrolls Hartford public school students from low-income families and the goal is to get students into four-year colleges and universities. This is a good program for administration of the YRBS. The thirty-seven Capitol Squash students, fourth through seventh graders, play squash for one hour and receive academic assistance for the second hour. This present study administered a modified version of the Middle School YRBS to Capital Squash (CS) students at Trinity College and compared these data to the YRBS administered in Rhode Island middle school students. Many results of this survey were surprising, including 15% more RI students than CS students rode in a car where the driver had been drinking; CS students' alcohol use was higher than RI students however more RI students used marijuana and prescription drugs; RI students thought, planned and attempted suicide at more than twice the rate of CS students. All results from the CS survey were used to determine the most common youth risk behaviors and then harnessed to create a brain health lesson. This lesson educated students about age appropriate anatomy, physiology, and risk behaviors that can impact the central nervous system. This survey revealed some surprising results and indicates the full YRBS survey would be more impactful with a larger sample of Hartford students.

85.
STUDY OF BRAIN AND ALCOHOL RESEARCH IN COLLEGE AGE STUDENTS (BARCS)
Alex Bednarek '18
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Shashwath Meda MA, Godrey Pearlson MD, Olin Neuropsychiatry Research Center, Institute of Living

It was once thought, within the scientific community, that the brain stopped developing after adolescence. Thanks to advancements in analytical techniques and behavioral tests, neuroscientists now know that the human brain continues to mature through a person's 20's (Johnson, Blum, Giedd 2009). College students run extreme risk for increasing alcohol consumption for a number of reasons. Iconis et al (2014) found that a combination of individual, environmental and demographic factors are associated with an increased risk in alcohol use, and it is quite often student athletes that are susceptible. In the Brain and Alcohol Research in College Students

(BARCS) study, 297 students from Trinity College, Central Connecticut State University and Yale University documented their alcohol research over a three-year period to determine effects of alcohol consumption on resting brain state activity. Researchers looked at variables associated with drinking such as pass-out/blackout episodes, number of drinks during binge episodes in last 6 months, number of binge episodes in last 6 months and total drinks in last 6 months, to determine severity (no drinking, moderate, chronic) of drinking on resting brain state. Voxel based functional magnetic resonance imaging (fMRI) analysis suggested that chronic drinking an effect on the resting brain states of college age students that participated in the BARCS study. Comparisons between resting state and drinking variables displayed eight significant networks to be analyzed based on their signal to noise characteristics. Of these eight networks, four showed decreases in functional connectivity when greater alcohol consumption was found within associated drinking variable. These results show that heavy or chronic drinking causes a decrease in functional connectivity within the brain.

86.
IMPROVING THE VISUAL SCREENING OF 3-YEAR-OLDS AT A PRIMARY CARE CLINIC
Margaret Curlin '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Catherine Wiley, MD, and Patricia Garcia, MD, Primary Care, Connecticut Children's Medical Center, Community Health Center, Inc.

Background: Delay in diagnosis of amblyopia increases the risk of permanent visual damage and even blindness. The AAP recommends visual acuity screening beginning at age 3 at each annual well child visit. We aimed to improve and sustain visual screening rates in 3-year-olds to 90%.

Design/Methods: A retrospective analysis was conducted using data from the patient charts of each 3 and 4-year-old receiving well child care to determine trends in monthly screening rates, referral rates, and the rate of attendance at referral appointment. Barriers were identified and sequential interventions were planned and implemented as necessary.

Results: The vision screening rate of 3-year-olds decreased from 93 to 76% following a change in system operations. Evaluation of a subsequent intervention demonstrated a sustained increase in screening rate to 94%. The referral rate for 3-year-old children with abnormal screening results was 40% on average, and 45% for 4-year-olds. Approximately 13% of patients that were referred attended a follow-up appointment with an eye care specialist.

Conclusion/Discussion: Although vision screening rates decreased after a change in system operations, a successful intervention resulted in a sustained, and higher than baseline screening rate. The screening rate varied between 3 and 4-year-olds, which is likely because the majority of 3-year-old vision screenings included the use of an autorefractor, which requires additional training to use, while 4-year-olds used a Snellen wall chart. Referral rates continue to be relatively low; evaluation of this intervention is on-going. Future interventions should focus on sustaining high vision screening rates long-term, further analyzing and improving the rate of referral, attendance at referral appointments, and outcomes of referral.

87.
IMPACT OF A COMPREHENSIVE ANTIBIOTIC EDUCATION PROGRAM ON PATIENT SATISFACTION DURING HOSPITALIZED CARE
Justin Curran '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Booth Wainscoat, DO, Hartford Hospital Department of Infectious Disease

Antimicrobial stewardship (AMS) programs, at the broadest level, oversee the responsible distribution and use of antibiotics. Beginning January 1, 2017, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) issued mandatory requirements for all acute care hospitals to implement AMS programs, with JCAHO requiring a facet of AMS programs to involve educating patients on appropriate antibiotic use. The purpose of this quality improvement (QI) project is to observe the degree of understanding patients have regarding antibiotics, and if extra education yields high satisfaction with care. The intervention begins with patients taking a survey that assesses their knowledge and opinions of their antibiotics, course of treatment, the role of antibiotics in their health, and their desire for more information. Those who desire more information receive a folder of information, along with a verbal synopsis of the information by the antibiotic education team (AET). Following the survey, patients take a second survey measuring knowledge and opinions on the same metrics as in the pre-intervention survey, as well as if they felt the program increased their overall satisfaction. A student's t-test compared the results of patient's knowledge and opinions regarding antibiotics between the pre-intervention and post-intervention surveys, and found significant increases in patients' confidence with their knowledge regarding antibiotic resistance and their course of treatment, though not with the role of antibiotics in their health. The results also indicated that patients who agreed to participate in the project mostly expressed a strong desire to receive the additional information, and mostly reported high satisfaction with care following the intervention. Due to the narrow timeframe for the project to take place, several biases were incurred, however Dr. Booth Wainscoat, a medical expert, feels this to be a potential avenue for increasing patient satisfaction and deserving of a full study, the design of which is proposed as a component of this project.

88.
THE CLINICAL APPLICATION OF MESENCHYMAL STEM CELLS IN ORTHOPEDIC MEDICINE
Elizabeth DiRico '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH

Mesenchymal stem cells play an essential role in injury repair in the human body, this mechanism is also known as stem cell mediated healing. The application for this form of regenerative medicine is endless and relevant in many fields of medicine, but especially promising in orthopedic medicine. Current orthopedic surgery is centered on invasive procedures that present high risk and moderate outcome. Mesenchymal stem cells have seen very favorable results in the treatment of treatment for degeneration in the knee joint and degenerative disc disease. I argue that mesenchymal stem cells are in many cases a more effective treatment for orthopedic conditions. Regenerative medicine has many advantages over surgical intervention in terms of safety, success rate, patient satisfaction and functional improvement.

89.

ASSOCIATION BETWEEN GAD-7 AND DISTRESS THERMOMETER SCORING AND CORRELATION BETWEEN MEDICAL VISIT TYPE AND SUPPORTIVE CARE SEEKING BEHAVIOR IN THE GYNECOLOGICAL ONCOLOGY PRACTICE SETTING

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In cancer patients, psychosocial distress can result in adverse health effects (Snowden *et al.*, 2011). Since distress screening tools help to connect distressed patients to intervention resources that prevent these adverse effects from taking root, understanding and improving these tools is of the utmost importance (Anderson *et al.*, 2007). This study works to determine if the two distress screening tools employed by the Hartford HealthCare Cancer Institute, the GAD-7and the Distress Thermometer (DT) show agreement in their assessment of distress and to determine if there is any relationship between pivotal medical visit and patient consent to supportive care in gynecology oncology patients. Data for this study were obtained from the medical record of the Cancer Center Wellness Assessments collected from adult gynecological cancer patients seen for office visits at Hartford Hospital. Pearson's *r* correlation coefficient statistic was used in order to test the agreement between GAD-7 and Distress Thermometer scoring and the association between the presence of consent to supportive care and pivotal appointment time were tested parametrically with a multiple logistic regression approach and non-parametrically using chi-square. A strong correlation was found between GAD-7 and Distress Thermometer score (N=108, $r(107) = 0.81$, $p < .001$). This suggests that one tool could be removed from the Wellness Assessment. The results also indicate that there is not a statistically significant relationship between pivotal appointment time and supportive care seeking behavior ($p > 0.50$). However considering the small sample size analyzed (N=32), this value is considered to be statistically underpowered. The raw data suggests that patients making non pivotal visits were more likely to exhibit supportive care seeking behavior than patients making pivotal visits. This trend contradicts the recommendation that psychosocial distress screening be at "pivotal medical visits" (American College of Surgeons, 2015). In either case, these findings warrant further study.

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90.
EFFECTS OF PROBIOTICS ON MOTOR AND NEUROLOGICAL SYMPTOMS AND QUALITY OF LIFE IN PATIENTS WITH PARKINSON'S DISEASE
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Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Duarte Machado, MD Hartford Healthcare Medical Group - Neurology

Parkinson's Disease (PD) is a neurodegenerative disorder characterized by tremor, rigidity, and bradykinesia or slowness of movement. The most widely reported symptom in patients with PD is constipation, which affects more than 80% of patients and has been shown to be a result of an altered gut microbiome. Probiotics have been used to restore this altered gut microbiome and alleviate constipation in PD patients, but no study has been conducted that evaluates how alleviating constipation affects symptom control and quality of life. This study uses validated survey tools including, but not limited to, the PDQ-39, ADLQ, and UPDRS (Parts II and III), to evaluate the following questions: (1) do symptom control and quality of life differ between PD patients with and without constipation, (2) does a multi-strain, high colony forming probiotic alleviate constipation in PD patients, (3) does alleviating constipation in PD patients using a probiotic improve motor and neurological symptom control and quality of life, (4) is a high potency probiotic more effective at alleviating constipation than a less potent probiotic. Interim data analysis indicates that probiotics may improve sleep ($p < 0.05$) but the sample size is too small to find any statistical significance with other investigated parameters such as quality of life or motor examinations. The study will continue until sufficient statistical power is reached when at least 190 patients have been enrolled (anticipated approximately August 2017).

91.
THE ROLE OF ALCOHOL IN PEDESTRIAN INJURIES IN HARTFORD
Lilla Kis '18
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The aims of this research were to determine the prevalence of serum EtOH positivity in a population of patients struck by motor vehicles in the Hartford, Connecticut area, and to elucidate the effects of alcohol on the outcomes of these injured pedestrians. We conducted a retrospective review of the St. Francis Hospital Trauma Quality Improvement Program (TQIP) registry for patients who presented to the hospital after being struck by a motor vehicle between April 2014 and January 2017. Patients were stratified based on whether or not they had serum EtOH positivity and the two groups were analyzed for differences in time of day of injury, season, age, gender, ISS, GCS, ICU admission, ICU LOS, HLOS, discharge destination, and mortality. Pedestrians with EtOH positivity were more likely to be injured at night compared to those patients who tested negative for EtOH. Additionally, a significant difference in seasonal variation was noted between the two groups, with more injuries during colder months in the no alcohol group but no clear trend in the EtOH positive group. The EtOH positive group had significantly more males, but the two groups did not differ with regards to age, ISS, or GCS. There were no significant differences in ICU admission, HLOS, discharge destination, or mortality, but there was a trend towards shorter ICU LOS in the EtOH positive group.

92.
THE EPIDEMIOLOGY AND PREVENTION OF YOUTH SUICIDE
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Suicide is the second leading cause of death among youth and young adults ages 15-24 accounting for 5,491 deaths annually. For each suicide there are approximately 25 attempts representing a significant health care and economic burden to the U.S. This study is a descriptive epidemiological analysis of suicide and suicidal behavior among U.S. persons 15-24 years of age from 2010-2016. Suicide fatality data was collected from the Web-based Injury Statistics Query and Reporting System (WISQARS) maintained by the CDC. Sources of non-fatal suicide behavior were collected from the Youth Risk Behavior Survey. Variables included demographics (age, gender, race, ethnicity) method of suicide, and geographic location. Data tables, charts and maps generated using WISQARS are displayed in Adobe Captivate, an e-learning software module. In 2010, there were 4,600 suicides among youth ages 15-24 in the U.S. This results in $8,520,554,000 in medical and work loss costs. In Connecticut, there were 39 suicides totaling $72,613,000. Non-fatal suicide attempts resulting in hospitalization are higher among females than males (218 vs 155/100,000 persons). Males are more likely to use a more lethal method (firearms) than females (ingestions). The public health response to suicide is described at the national, state, and local level. Raising awareness of the scope of the problem and identifying young persons at high risk and providing referral to mental health treatment is an important of suicide prevention organization. The Jordon Porco Foundation is supporting a national campaign to implement programs at high school and college campuses to encourage creating a conversation about mental health as well as educating students to be confident in identifying the risk factors of suicide.

93.
COMPARISON OF BASELINE PSYCHOPHYSIOLOGICAL BIOMARKER: ANXIETY DISORDERS PATIENTS VS. HEALTHY CONTROLS
Kevin Makie '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Gretchen Diefenbach Ph.D, Anxiety and Disorders Center, Institute of Living

Psychophysiological biomarkers are becoming a topic of great interest in clinical psychology, especially how they relates to anxiety disorders. Recent anxiety based research has shown that sympathetic arousal and resting states are good predictors for the effectiveness of cognitive behavioral therapy (CBT) (Field, Beeson and Jones, 2015). Research has also revealed that persons who have been diagnosed with anxiety related disorders have different resting state biomarkers when compared to a healthy control (Inselet et al., 2010). In this study participant data was collected during the patient's intake or before the first therapy session at the Anxiety and Disorders Center. The data was collected using Biopac Systems and analyzed using Acqknowledge software. The data was then compared to healthy control baseline data that was collected from previous research. The biomarkers that were collected were end tidal CO_2 (eCO_2), EMG, heart rate variability (HRV), respiratory sinus arrhythmia (RSA), skin conductance level (SCL) and non-stimulated skin conductance response (NS.SCR) per 5 minutes. In total 23 patients (N=22) took part in the study, of which 7 were children (N=7) and 15 were adults (N=16). The healthy control

data was gathered from previous published research. There was only a significant difference in the eCO_2 in the adult group (AD 27.86% CO_2 +/- 3.22%, HC 36.6% CO_2 +/- 3.5%) (p=0.009). There was no significant difference in the adult SCL and NS.SCR as well as child eCO_2, SCL and NS.SCR. No data for HRV, RSA and EMG was presented because of the small sample size restricts the ability to accurately present the data. This study is still in the initial data collection phase with an ultimate goal of collecting data on 200 participants. Also, none of the patients have had CBT yet so the effectiveness cannot be tested.

94.
REVIEW OF INPATIENT PEDIATRIC CENTRAL LINE INFECTION EVALUATION AND MANAGEMENT AT CONNECTICUT CHILDREN'S
Kiley Nygren '17
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Central venous line (CVL) infections are a type of nosocomial infection. Certain pediatric patients have factors that increase their risk of infection, such as short bowel syndrome (SBS), cancer, age and weight. The immediate diagnosis of these infections is crucial in the timely management and treatment. There are many variations in regards to the best diagnosis technique and treatment recommendations in pediatric patients. The aim of this study was to look at the risk factors, diagnostic techniques, treatment methods, catheter removal and the length of hospital stay in hopes of determining how patients obtain better outcomes in the occurrence of a CVL infection.

We obtained a database containing patients with suspected line infections and reviewed the charts corresponding to those infections from 2015 and 2016. The hospital location where culture was drawn, number of blood cultures, consults, central venous line location, possible risk factors, antibiotic used, catheter removal and length of hospital stay were gathered.

It was found that patients under age 3 accounted for 50% of CVL infections and greater than 50% of infections were found in patients weighing less than 25 kg. Of the infections studied 61% were found in patients who had recurring CVL infections and of those recurring infections 64% had SBS. Of the patients who had positive blood cultures in the ED, the median length of stay was 10 days and 40.5 days when diagnosed in the PICU. The recommendations suggest a peripheral blood culture be drawn on all patients prior to antibiotic; only 33.3% of patients had peripheral blood samples drawn within 24 hours.

By looking at the diagnosis, treatment and management of CVL infections at CCMC we were able to determine increased rick factors, which techniques give the best outcomes and provide recommendations in the treatment of pediatric CVL infections.

95.
UNNATURAL SELECTION: THE RECENT EVOLUTION OF PEDIATRIC SURGERY IN THE UNITED STATES, 2005-2014

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Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Brendan T. Campbell MD, MPH, Katherine W. Herbst M.Sc, Department of Pediatric Surgery, Connecticut Children's Medical Center, Hartford, CT

The subspecialty of pediatric surgery developed as the need for specialized treatments of uncommon and complex congenital anomalies and childhood surgical diseases increased. As a result to the increase in pediatric surgeon subspecialties, the objective of the study was to determine whether the breadth of surgical cases being performed by pediatric surgeons in the United States has become less diverse over time.

The study design used a retrospective cohort with the setting being a non-profit, tertiary care pediatric hospitals participating in the Pediatric Health Information System database. Patients included were <12 years who underwent one of nine common outpatient surgical procedures between January 2005 and December 2014. Patients undergoing concurrent procedures, and procedures performed by surgeons other than pediatric surgeons, urologists, or otolaryngologists were excluded. The main outcome measure was temporal trends in the proportion of procedures performed by pediatric surgeons

Procedures were identified by ICD-9 code and grouped into three categories: 1) Abdominal (anal fistulotomy, umbilical herniorrhaphy, port placement), 2) Head/neck (thyroglossal duct cyst excision, branchial cleft excision, cervical lymph node excision), 3) Genitourinary (inguinal herniorrhaphy, orchiopexy, circumcision). Results included were 194,026 procedures, 36,729 (19%) abdominal, 9,371 (5%) head/neck, and 147,926 (76%) genitourinary. Pediatric surgeons performed nearly all of the abdominal procedures, which demonstrated little temporal change. Head/neck and genitourinary procedures showed a significant downward trend for pediatric surgeons during the study period ($p<0.001$). Head/neck cases performed by pediatric surgeons declined from 56.3% to 35.8%, while the proportion performed by otolaryngologists rose from 43.7% to 64.1%. Similarly, the proportion of genitourinary cases fell from 48.0% to 31.7% for pediatric surgeons, and increased from 52.0% to 68.0% for urologists.

In conclusion, the breadth of cases performed by pediatric surgeons has evolved significantly over time. These data provide relevant and actionable information for pediatric surgical workforce planning in the United States.

96.
DETERMINING THE EFFICACY OF DOXYCYCLINE IN THE PREVENTION OF MANDIBULAR THIRD MOLAR EXTRACTION POSTOPERATORY COMPLICATIONS WITH RESPECT TO ITS PREDECESSOR TETRACYCLINE.

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Third molar surgery has become a routine procedure in the United States requiring the removal of one or all the maxillary and mandibular third molars. The most common post-operative risk factors

of third molar extraction procedures are alveolar osteitis (dry socket) and infection, both of which are believed to be mitigated by the use of antibiotics. Topically applied, prophylactic tetracycline has been proven to effective in reducing the incidence of dry socket and infection, however, the efficacy of newly utilized doxycycline in prevention of these two common risk factors must be demonstrated against its predecessor.

Retrospective analysis was done for 1096 mandibular third molar extractions conducted on 598 patients seen at Avon Oral and Maxillofacial Surgery LLC. during the year 2016. Intrasocket doxycycline was applied to the extraction site post-operatively for all procedures included in the study to mirror two previously conducted studies where intrasocket tetracycline was used instead, allowing for direct comparison of statistical findings between the two analogous studies. All data was compiled from the DSN electronic medical record software utilized by the practice for all mandibular extractions of teeth 17 and 32 regardless of age, sex, and past medical history.

Data analysis of a combined 2978 teeth between all three studies demonstrated statistically significant differences in tetracycline and doxycycline efficacy in full bony impaction procedures overall and early (overall P= .005; early P= .002) but not in delayed infection (delayed P= .405) as well as overall and early infection incidence (overall P=.012; early= .011). Erupted, soft tissue impacted, and partial bony impacted third molar did not demonstrate any significant difference in post-op complication prevention between both antibiotics. Statistical analysis did not demonstrate any significant difference in doxycycline efficacy for overall dry socket incidence (P= .070). However, no available literature comparison for dry socket by impaction type was able to be find.

Given the functional and structural similarities between doxycycline and tetracycline, there was no expected significant difference in the efficacy of either topical antibiotic. However, the results of this study suggest that tetracycline is less effective at reducing the incidence of postoperative complications in more complex surgeries where trauma to the patient and heal time are greater. With intrasocket doxycycline's ability to reduce the incidence of post-operative complications relative to tetracycline in more traumatic extraction surgeries, not only will patients healing success be increased while the need for follow up treatment interventions reduced, subsequent additional treatment costs to the surgeon will be reduced as well.

Key terms: alveolar osteitis, prophylactic

97.
PROFESSIONAL IDENTITY: A QUALITATIVE LOOK INTO THE PERSPECTIVES OF NON-PHYSICIAN CARE PROVIDERS
Rachael Smith '18
Faculty Sponsors: Alison Draper; Maryann McGuire R.N., M.P.H; Francis DiMario, M.D., Connecticut Children's Medical Center

Interprofessional practice (IPP) has become an increasingly common method of providing patient care within healthcare systems. However, the role that interprofessional practice plays on the professional identities of clinicians is unknown.

This study examined the perspectives of non-physician healthcare providers at Connecticut Children's Medical Center about how involvement in interprofessional practice affected their own professional identity.

A voluntary, non-validated survey was distributed to 67 APRNs and 38 PAs at CCMC through an intra-institutional email list. The survey consisted of demographic information and participant responses to statements along a five-point Likert-scale ("strongly agree" to "strongly disagree") separated into 3 domains (professional identity, role blurring, interprofessional practice).

To analyze by domain, participant responses were interpreted to show overall agreement or disagreement with each domain. For each individual statement, the means and standard deviations were calculated. Mean scores > 3.5 showed statement agreement and mean scores < 2.5 showed statement disagreement. Mean scores between 2.5 - 3.5 showed neutral statement response.

11 out of a total of 105 subjects participated in the study. Responses showed overall agreement with the interprofessional practice domain, suggesting that participants regularly participated in interprofessional practice and found it beneficial to patient care and their experience. Responses showed overall disagreement within the role-blurring domain, suggesting that team roles typically remained distinct and individuals did not practice skills outside their level of training. Responses showed overall agreement to the professional identity domain, suggesting that participants understood their roles as professionals and believed their personal values coincided with their professional values.

Limitations of this study included the small window of time available for the study. Due to this there were limited numbers of survey responses and direct participant interviews could not be conducted. Further qualitative studies done to examine the effects of teamwork and role blurring on professional identity are needed.

98.
THE EFFECTS OF LOWER EXTREMITY KINEMATICS ON UPPER EXTREMITY JOINT STRESSES AND BALL VELOCITY IN COLLEGIATE AGED PITCHERS
Ryan Vultaggio '18
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Matthew Solomito, PhD, Connecticut Children's Medical Center

Recent studies have indicated that the number of arm injuries in adolescent baseball pitchers has increased in the last decade. The majority of injuries occur to the elbow or shoulder of the pitcher, however it is unclear as to what causes these injuries as prior research points to overuse, poor mechanics, and early sports specialization. Specifically in question is how the lower extremity kinematics of the hip and knee influence upper extremity joint stresses and ball velocity in collegiate pitchers. Kinematic data was obtained from 143 collegiate pitchers between the ages of 17 and 24 using modern three-dimensional computerized motion analysis techniques. Linear regression analysis tests indicated that the knee flexion and hip internal rotation independently affected upper extremity joint stresses. Increased knee flexion at foot contact (FC) resulted in an increase in ball velocity (p-value:0.01 ,β:0.09), while decreasing glenohumeral stress (p-value: 0.02, β:-0.21) and elbow varus moment (p-value:0.05, β:-0.24). In addition, it was found that internal hip rotation resulted in an increase in glenohumeral stress (p-value:0.01, β:0.30) as well as elbow varus moment (p-value:0.001, β:0.38). These results were seen from FC through maximum internal rotation (MIR). The increased hip rotation allows for greater trunk rotation contributing to the kinematic chain. Strength and conditioning professionals can use this information to focus training to specific muscle groups. Pitchers should focus on major muscles in

the lower that contribute to core stability, leg flexion and extension as this will allow them to reach the desired position at foot contact.

99.
UTILITY OF THE VIDEO CAPSULE ENDOSCOPY IN THE PEDIATRIC POPULATION: A SINGLE CENTER RETROSPECTIVE CHART REVIEW PROTOCOL
Brenna Weber '17
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Upper and lower/colon endoscopies are used to provide information on issues in the gastrointestinal tract by being able to look along the small and large intestines with a camera. Due to the length and complexity of the intestinal tract, gastrointestinal issues are unable to be diagnosed because of the difficulty in anatomically examining the small bowel. Diagnosis of patients with unexplained gastrointestinal symptoms such as suspected Crohn's disease (CD), obscure gastrointestinal bleeding (OGIB), polyposis syndromes (presence of polyps), malabsorption/protein-losing enteropathies, and abnormal recurrent abdominal pain has shown to only be detected from within the small bowel, proving a need for testing in addition to endoscopies.

Video capsule endoscopy (VCE) has become a superior additional diagnostic test approved for use in children from 2 years of age and up with reports of utility in children as young as 8 months of age. For this research, data will be collected from RAPID and EPIC databases for VCE video/image data and patient demographic information, respectively. This data will be compiled into an Excel database. A retrospective chart review will be completed to evaluate the utility of VCE, performed at CCMC from April 2010- January 2017, in children who had normal conventional upper endoscopy and colonoscopy, but continue to exhibit symptoms of obscure gastrointestinal symptoms. The data will be analyzed to support previous studies of safety of use in children, determine better management changes/outcomes as a result of the VCE study, and identify possible new indications/contraindications in VCE use in pediatric populations.

100.
PRELIMINARY INVESTIGATION OF THE FIT TEENS INTERVENTION ON THE IMPROVEMENT OF ADOLESCENT PAIN CATASTROPHIZING, DEPRESSIVE SYMPTOMS, SLEEP DIFFICULTY, AND PAIN INTENSITY AT CONNECTICUT CHILDREN'S MEDICAL CENTER (CCMC)
Fabiola Yun '18
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Objectives: Juvenile fibromyalgia (JFM) is a syndrome that causes chronic musculoskeletal and joint pain in pediatric patients. The problems associated with JFM include heightened emotional distress, often associated with anxiety and depression, pain sensitivity, sleep difficulty. Fibromyalgia Integrative Program for Teens (FIT Teens) is a new intervention that combines cognitive behavioral therapy (CBT) techniques and specialized neuromuscular exercises to improve daily functioning in adolescents with JFM. The objective was to investigate the FIT Teens

intervention on improvements in pain catastrophizing, depressive symptoms, sleep difficulty, and pain intensity from the treatment start and to the end of the treatment.

Methods: Adolescents with JFM (n=16, all female, ages 12-17 years) participated in the 8-week intervention. Participants completed measures of pain catastrophizing and depressive symptoms before and after the intervention. They also completed daily measures of sleep difficulty and pain intensity during the intervention period. Means for the first and last 7 days of the intervention were calculated for sleep difficulty and pain intensity.

Results: Participants showed significant decreases in depressive symptoms (P<0.05) and pain intensity (P<0.05) from pre- to post-intervention. Results also indicated a significant positive correlation between sleep difficulty and pain intensity at pre-intervention stage among participants (P<0.01). There were strong correlations between sleep difficulty and pain intensity at the end of the treatment and pain catastrophizing and depressive symptoms at the treatment start and at the treatment end.

Discussions: Adolescents with JFM reported significant improvements in pain catastrophizing and depressive symptoms following the intervention. The data did not support that the intervention helped participants to improve in sleep difficulty and pain intensity. Further work is needed to assess these outcomes using a bigger sample size.

Key words: adolescents; juvenile fibromyalgia; FIT Teens intervention; functioning

NEUROSCIENCE

101.

EFFECTS OF THE KETOGENIC DIET ON THE ESTROUS CYCLE AND GLUCOSE REGULATION IN FEMALE RODENTS

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Faculty Sponsors: Susan A. Masino, David Ruskin

The ketogenic diet (KD) has a long history of various applications, including treatment of refractory epilepsy and potentially catamenial epilepsy, which affects women during specific points within their menstrual cycle. It is a high-fat, low-carbohydrate and moderate-protein containing diet which increases blood ketones and decreases/stabilizes glucose. Increased application of this diet in adults necessitates a better understanding of the diet's effects on women of child-bearing potential since it has been implicated in causing menstrual irregularities in women in limited studies. The current study sought to determine the effects of a KD on reproductive cycles in BTBR, CD-1, and EL mice and Long-Evans (LE) rats. All rodents' estrous cycles were evaluated daily with cytological analysis. Animals were placed onto the strict KD (6.6g of fat: 1g (carbohydrate + protein)) or moderate KD (3:1). Blood histology and weight data were collected for each animal throughout the study. We also studied how a KD alters glucose regulation throughout the estrous cycle, because previous research does suggest that glucose levels spike during ovulation (peak fertility). Therefore, a continuous glucose monitoring system (CGMS) was used in a subgroup of our LE rats to study glucose regulation across the estrous cycle. Results have confirmed that the strict KD had the greatest effects on estrous cycle regulation when compared to moderate KD data, particularly in our BTBR mice. Data collection and analysis of the effects of the KD having a stabilizing effect on glucose regulation across the estrous cycle in our LE rats is ongoing.

102.
ESTABLISHING A REFERENCE DATABASE FOR COLLEGIATE ATHLETES USING THE ELITE BALANCE PROTOCOL
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Recent studies have shown that static balance alone is not enough to appropriately assess post-concussion balance and recovery; this is because these tools are unable to identify the affected systems of a concussion. Therefore, it has been proposed that a dual task (cognitive load and balance) is used as most athletes are required to perform both a physical and mental task to be successful at their sport. Dual tasks require the patient to split his/her attention between balance and a cognitive load. Thus, testing patients in a dual task condition is more applicable to a real world setting. This study was a prospective, non-randomized study that sought to validate the use of the Elite Balance Protocol (EBP) as a tool to assess post-concussion by establishing an EBP reference data set for non-concussed collegiate athletes. The data was collected using a Nintendo Wii balance board and Matlab. The results indicated an overall trend for decreased sway area when subjects performed the dual task balance compared to single task balance conditions. The results of this study are consistent with other studies that have noted an improvement in balance when a dual task was administered. Therefore, using the collected reference data it is possible to compare EBP data collected from concussed athletes to the reference data collected in this study; thus allowing for a clinical tool to assess and track the recovery of a concussion.

103.
ACQUISITION OF DEEP BRAIN HIPPOCAMPAL EEG IN RATS
Natalie Bruno '20
Faculty Sponsor: J. Harry Blaise

The hippocampus is the region of the brain involved in learning and memory. Within the hippocampus, there are two regions of interest; the Dentate Gyrus (DG) and the Cornu Ammonis 1 (CA1). There is a correlation between the two regions, however, the direct relationship is still unknown. The purpose of this study is to limit the cross-talk to analyze what the role of the two regions are. The CA1 and DG are very close in proximity, this has caused issues in isolating the frequencies from each region respectively due to cross-talk in previous research. The methodology utilized to carry out electro-encephalogram (EEG) recording includes the production of electrodes and performing surgery on rats. The electrodes created include ground/reference electrodes and recording electrodes. Once electrodes are created, the researchers may perform the stereotaxic surgery. The rat is put under anesthesia using initially isothesia liquid to relax the rat and then is injected with a mixture of ketamine anesthetics at the intraperitoneal site and is then prepared for surgery. An incision is made and the skull of the rat is cleaned to the point where Lambda and Bregma can be identified. Lambda and Bregma are reference points as to where to implant the electrodes. Once the electrodes are in place, they are capped with dental cement and the rat is left to recover for at least 24 hours before recording began. Another research group in the lab was responsible for the EEG analysis and data processing. In conclusion, in this study we constructed electrodes which we implanted into the DG and CA1 which were then used to record EEG activity and to assess whether signal processing methods could remove the cross-talk.

104.
ANALYSIS OF NEUROLOGICAL RESPONSE TO AGGRESSIVE AND MITIGATING LANGUAGE USING FMRI
Samuel T. Bryan '20
Faculty Sponsor: Dan Lloyd

Functional Magnetic Resonance Imaging (fMRI) technology has been used for decades as a metric for determining how the brain responds to stimuli. In this particular study, fMRI data provided by the Human Connectome Project was used to see the anatomical differences between the neurological response to language that is either aggressive or mitigating description of a person. To do so, one portion of a fifteen-minute movie clip was broken into those two categories plus a control. The timeframe for each was analyzed using a MATLAB t-test equation that provided activated regions of the brain with a p-value less than $0.001/40$. Those values were then recorded, averaged based on their corresponding section of the movie, and categorized based on similarity in the strength and overall amount of activation for each region. This procedure showed that certain regions in the auditory and cerebellar networks were present almost exclusively in the aggressive scenes while regions in the default mode, subcortical, and somatomotor networks were activated during the mitigating scenes. Certain anatomical regions like the insular cortex, cuneus, and inferior frontal gyrus had distinct activation in one category, while the postcentral gyrus had nearly no activation whatsoever. These results are to be used as a pilot study for the purpose of phenomenological analysis in future studies.

105.
MATERNAL ESTROGEN EXPOSURE MAY BE LINKED TO AN INCREASED RISK OF AUTISM SPECTRUM DISORDER
Sarah Bunker '17
Faculty Sponsor: Molly Helt

The current study explored the possibility that maternal estrogen dominance serves as a risk factor for having a child with autism. An online survey was sent to both biological mothers of autistic children (n=253) and biological mothers of non-autistic children (n=221). The survey presented a series of questions pertaining to both endogenous and exogenous factors and exposures that could increase estrogen levels. The data on exogenous exposures is treated in another paper (Helt, Bocobo, Lasky, & Bunker, in progress). The current paper presents the findings on exogenous maternal estrogen exposure and autism risk (e.g., previous history of trauma, stress, diet, & toxin exposure). Mothers of children with ASD reported higher consumption of non-hormone free animal products and children, reported putting more endocrine mimicking chemicals on their bodies daily (6.7) than control mothers (5.2), and reported having "very high" levels of stress during their pregnancies compared to control mothers. Furthermore, mothers of children with ASD reported a higher incidence of traumatic events during their pregnancies, specifically during the pregnancy with their child that received an ASD diagnosis, and a higher lifetime incidence of PTSD. Overall, there are significant differences related to maternal estrogen exposure between the pregnancies of mothers with and without a child with ASD. These results suggest that future research should investigate the possibility of a direct link maternal between estrogen exposure and autism risk.

106.

IMMUNE CYTOKINES ALTER EXPRESSION OF A REGULATOR OF GABAERGIC INTERNEURON DEVELOPMENT: RELEVANCE TO SCHIZOPHRENIA AND AUTISM SPECTRUM DISORDERS
Catherine Cebulla '17
Faculty Sponsors: Susan A. Masino, Erika Pedrosa, M.S., Herbert Lachman, M.D

Schizophrenia and Autism Spectrum Disorders (ASD) are subject to overlap not only in their phenotypes, but also in their pathologies and genetic risk factors. There is evidence that the mechanism of dysfunction in these neurodevelopmental disorders converges at GABAergic interneuron development during the prenatal period in a gene by environment interaction: the effect of inflammatory molecules released during maternal immune activation and certain disease-causing genetic variants are additive risk factors for developing both ASD and schizophrenia.

Considering this hypothesis, we wanted to determine whether the expression of DLX6 antisense RNA I (DLS6-as1), a regulator of important downstream transcription factors in GABAergic interneuron development, was affected by treatment with immune cytokines, implicated as mediators of maternal immune activation.

In this study, patient-specific induced pluripotent stem cells (iPSCs), reprogrammed into neural progenitor cells (NPCs) derived from fibroblasts of healthy individuals and schizophrenia patients who carry a 3 megabase deletion on 22q11.2, were used to model these disorders *in vitro.* The iPSC-derived NPCs were treated with tumor necrosis factor alpha (TNF-α), interferon alpha-2 (IFNα-2), and transforming growth factor beta-1 (TGFβ-1), important immune and inflammatory signaling molecules. Real-time quantitative polymerase chain reaction (RT-qPCR) was used to quantify relative gene expression of DLX6-as1 as a result of cytokine treatment.

It was found that TNF-α significantly increased DLX6-as1 expression in healthy control cell lines, and IFNα-2 significantly decreased DLX6-as1 expression in healthy controls, and DLX6-as1 expression was significantly lower in healthy controls than 22q11.2 deletion cell lines, following IFNα-2 treatment. Treatment with TGFβ-1 was not significant. These results highlight a possible convergence of immune cytokines and genetic dysregulation on the development of GABAergic interneurons in the fetal brain as risk factors for neurodevelopmental disorders.

107.

A RETROSPECTIVE ANALYSIS OF PEDIATRIC BRAIN TUMOR INCIDENCES AT CONNECTICUT CHILDREN'S MEDICAL CENTER (CCMC)
Catherine Cebulla '17
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Hartford, CT

Tumors of the brain and central nervous system (CNS) are the most common type of pediatric cancer. In the United States, the three most prevalent pediatric brain tumors are pilocytic astrocytoma, followed by medulloblastoma, and ependymoma. This national trend generally applies to that at individual hospitals, and it is important for neurosurgery departments to take a retrospective analysis of brain tumor data every few years to ensure effective hospitalization and care, and to look for trends in the incidences of brain tumor cases. The neurosurgery team has

noted a rise in ependymoma cases since 2015 and these tumors have the potential to be especially malignant due to their mechanism of metastasis and location in the brain.

As a result, the aim of this study is to retrospectively analyze the entire pool of pediatric brain tumor data at CCMC since 2015, with a specified look at whether demographic or social factors may be biasing this higher incidence of ependymoma cases. The purpose of this analysis is to provide insight into which patients, and their brain tumor diagnoses, are using up hospital resources the most.

Patient data, collected in the electronic medical record EPIC, was run through regression, crosstabulation and Chi-square statistical analyses, and there were no significant correlations found with any demographic or sociological factors and the incidence of ependymomas. Benign tumors were significantly correlated with a shorter length of stay in the hospital and a higher patient age group. This data supports that the more malignant tumors such as ependymoma and medulloblastoma pose the most difficulty for neurosurgeons in treatment and require a greater usage of hospital resources.

The retrospective analysis of pediatric brain tumor patient data continues to be important not only for the neurosurgery department to evaluate their care of patients within the hospital, but also to compare trends between CCMC, other medical institutions, and nationally observed trends. Additionally, this analysis will aid the neurosurgery team at CCMC in understanding which patients require a greater allotment of time, care, and resources, and will hopefully help toward achieving better patient outcomes.

108.
ANALYZING THE ABILITY OF NEUROBLASTOMA CELLS TO RESPOND TO STRESS USING ATP DETERMINATION AND CELL VIABILITY TESTS
Ahmad Chughtai '20, Morgan McKeown '20
Faculty Sponsor: William Church

Lifestyle (exercise) and nutrition (supplements, low calorie diets) have been implicated in maintaining appropriate cognitive function as humans age. As a result, understanding the mechanism(s) by which neurons are protected from toxin-induced neurodegeneration can provide useful information regarding these health benefits. This research project characterized assays for two important measures of cellular health: ATP production and mitochondrial superoxide radical (mSOR). SH-SY5Y neuroblastoma cells were subjected to rotenone or hydrogen peroxide treatments and mROS and ATP levels quantified using commercially available kits. A concentration effect was observed for ATP generation in cells treated with rotenone for 48 hours. Following a 30 min. treatement with 5μM H_2O_2 mSOR generation was attenuated with increasing concentrations of a probiotic plant dietary supplement (24hr pre-treament; Immunity©, BodyandEden) These results provide interesting preliminary data regarding the utility of using ATP generation and mitochondrial generated superoxide radical to explore neuroprotective mechanisms in a human neuroblastoma cell line.

109.

PREVALENCE OF TRAUMATIC BRAIN INJURY IN ADULT FEMALE VICTIMS OF DOMESTIC VIOLENCE
Olivia DeJoie '17
Faculty Sponsor: Sarah A. Raskin

Domestic violence often includes physical blows to the body, the use of weapons, and strangulation. As a result, traumatic brain injury (TBI) can be a result of domestic violence. However, survivors of domestic violence may not be aware that they have experienced a TBI. Individuals who have experienced TBI may present with a variety of symptoms, such as impaired memory and attention, emotional instability, and sensitivity to certain visual or auditory stimuli. To determine whether victims of domestic violence have sustained a TBI, a battery of cognitive, mood, and personality measures were administered to six participants who had experienced domestic violence. All participants screened positively for a TBI based on the HELPS brain injury screening tool, which includes questions about blows to the head, loss of consciousness or confusion, and other problems. The most commonly reported problems in everyday life were anxiety, headaches, and dizziness. The results of the study indicate that domestic violence often results in TBI, and that victims of TBI experience difficulties related to the TBI in daily life.

110.

DETERMINING BRAIN REGIONS ACTIVATED BY IMAGES OF DOGS, MAMMALS AND CHILDREN USING HCP FMRI DATA
Sasha DiNitto '17
Faculty Sponsor: Dan Lloyd

The bond between animals and humans is a topic of interest today, and many animals are being used for different types of animal assisted therapy. This experiment sought to determine areas of the brain activated when people viewed dogs, non-human mammals, and children. Seventy participants underwent a 7T fMRI as a part of the Human Connectome Project. During the imaging, they viewed a film that was 61 minutes long. Dogs, mammals, and children appeared for a total of 26, 40, and 252 seconds, respectively. Independent component analysis was used to extract brain areas of interest, and each activity caused by dogs, mammals, or children, was compared to baseline activity. The results showed significant activation in the postcentral gyrus and middle temporal gyrus for dogs, the middle occipital gyrus, postcentral gyrus, middle temporal gyrus, and fusiform gyrus for mammals, and the calcarine gyrus, cuneus, middle temporal gyrus, and fusiform gyrus for children. These areas showed that there may be specific visual areas activated for each stimulus, with overlap between them. The results can be used to better understand perception of different yet related stimuli. The areas activated by animals also provide some insight into the benefits of animal assisted therapy.

111.
PERSISTENT EFFECTS OF THE KETOGENIC DIET ON THE CORE SYMPTOMS OF AUTISM IN BTBR MICE
Elizabeth M. Foley '17
Faculty Sponsor: Susan A. Masino

This study investigates persistent behavioral effects of the ketogenic diet (KD) on a mouse model of autism spectrum disorder (ASD). The KD has been shown to suppress seizures even after reversal to control diet (CD), indicating that it is potentially effective in reversing the disease. Studies on ASD behaviors in the BTBR mouse model found that KD treatment increased sociability in a three-chamber test and decreased self-directed repetitive behavior. This study focuses on the BTBR mouse model to determine if improvement in ASD-associated behaviors persists when animals are returned to a CD. To do so, BTBR mice (5 weeks of age) were randomly assigned to one of three diet groups: CD, KD, and KD reversal. All mice underwent initial behavioral testing in a three chamber test and then both KD group and KD reversal groups were switched to KD for three weeks and underwent additional testing. Subsequently, both groups underwent three additional weeks of KD; however in the last 5 days the KD reversal group was switched back to CD. Although it was expected that enhanced sociability would be detected and prolonged even after reversal to the CD, no significant improvements in sociability were found in any treatment group. These data conflict with previous research and ongoing research will consider methodological differences and include additional measures of sociability including frontal contact and self-directed repetitive behaviors

112.
CASE STUDY: TRANSTIONING FROM PEDIATRIC TO ADULT MEDICAL CARE IN SICKLE CELL DISEASE
Elizabeth M. Foley '17
Faculty Sponsors: Alison Draper, Maryann McGuire RN, MPH, Donna Boruchov, MD, Pediatric Hematology & Oncology, Connecticut Children's Medical Center, Hartford, CT

Sickle Cell Disease (SCD) is chronic congenital hemoglobinopathy, which affects the body's red blood cells and induces a series of disease-related complications. SCD is the most common inherited disorders affecting approximately 80,000 people in the United States. In Connecticut alone, 466 children and ~700 adults have been identified with SCD. Over the past decade, mortality rates for patients with SCD have decreased by 22-35% in children 5-19 years of. Although life expectancy has drastically increased, a trend of increased health complications during age range of 14-24 years has been identified. This age range corresponds to the transition period from pediatric to adult medical care, and has been correlated with lack of patient readiness for health care management.

The following case study is centered around a 17-year-old male patient diagnosed with severe SCD, which has led to several health complications including hypertension, splenomegaly, acute chest syndrome, and avascular necrosis of the left hip, to name a few. Previous studies have suggested that that severity of disease has a negative impact on patients' readiness for transitional care. As the patient is nearing the age that warrants transition to adult hematological care, the main goal was to assess his readiness for transition characterized based on his thoughts about the process, prior knowledge, interest in learning more, anticipated difficulty, and perceived

importance of adult care. It was determined that the patient had unanswered questions and general concerns regarding the process of transitioning to adult care including the ability of his new care team to handle pain management, insurance coverage, and the establishment of a good relationship with his doctors. It is suggested that he would benefit from a fully functional transitional care program that caters to patients with sickle disease of all ages. Furthermore, transitional programs may help increase patient readiness, reduce any fear and/or anxiety surrounding the process, and ultimately decrease morbidity and mortality during the period of transitional care.

113.
ASSESSING BALANCE USING THE ELITE BALANCE PROTOCOL (EBP) AND VALIDATING THE USE OF THE WII BALANCE BOARD TO TRACK THE RECOVERY OF A CONCUSSION
Anna Hackett '20
Faculty Sponsor: Sarah A. Raskin, Senior Research Associate: Zachary Bitan '17

The topic of concussions is one that has become widely more popular in the past few years and the lack of information about them is alarming. Recent studies have shown single-task tests are not enough to appropriately assess post-concussion balance and recovery. An athlete is never performing solely a balance task or a cognitive task, both are always occurring together; therefore, through the use of the Elite Balance Protocol (EBP), this study assesses college athletes in a series of dual-task situations testing their balance and cognitive ability concurrently. This study will create a pool of reference data using healthy control subjects with which the concussed individuals' performances will be later compared. Each subject is required to perform balance tasks with double and single-leg stances, eyes-open and eyes-closed conditions, and finally a cognitive load will be added to the eyes-closed tests of both balance stances. It has been found that when comparing single-leg postural sway, healthy subjects had an increase in postural sway when eyes were closed rather than open. This postural sway decreased, however, when adding a cognitive load. This data is consistent with previous studies that found similar improvement under dual-task situations. Using this information, concussed individuals can be tested to see if their balance would improve as well when performing a cognitive task with the balance task. It is expected that the postural sway of a concussed individual will not decrease when adding a cognitive load given that the impaired brain would be unable to split its attention by displacing postural attention to more automatic processes.

114.
EVALUATION OF A NEW CELL VIABILITY PROTOCOL
Georgia Mergner '18
Faculty Sponsor: William Church

Previous research in this lab has shown that ascorbic acid treatment is neuroprotective in differentiated SH-SY5Y cells. However, the use of ascorbic acid treatment in undifferentiated SH-SY5Y cells resulted in loss of cell viability. This study sought to reproduce previous results using a new cell viability protocol. SH-SY5Y cells were grown and differentiated using retinoic acid over the course of 6 days. Undifferentiated and differentiated cells were then treated for 12 hours with 200 uL of 14.2 uM ascorbic acid. Cell viability was determined using a commercially available fluorescent assay (LIVE/DEAD Viability Cytotoxicity Assay Kit; Molecular Probes).

The utilization of a Spectrum Cell Plate Reader was compared to previous results obtained using fluorescence microscopy. Results indicate this new protocol was consistent with previous findings in that ascorbic acid decreased cell viability of undifferentiated cells, while having no affect of differentiated cells. Utilization of the plate reader allows for a significantly higher throughput.

115.
VIDEO SCORING AS A BEHAVIORAL ANALYSIS TECHNIQUE FOR MICE
Mira Nakhle '20, Roxana Alvarez '20
Faculty Sponsors: Susan A. Masino, David Ruskin.

In animal studies, it is important to have a quantifiable method of analyzing behavioral changes. Video scoring is a crucial way to evaluate behavioral abnormalities by allowing for the isolation of desired variables. The scoring process consists of recording a rodent in a certain environment and later analyzing the behavior of the rodent throughout a specific time frame. This form of analysis allows for the thorough observation of subtle differences in behavior that might be missed when watching behaviors in real time. This is because the method allows for multiple people to video score the behaviors in offline settings. Additionally, this form of testing is able to be completed without human interaction or proximity which could potentially influence test results. Thus far, the data collection technique has allowed for the analysis of social and repetitive behaviors in epilepsy and autism studies. Responses to pain, brought upon by different stimuli, have also been investigated using this method. This is measured by timing pain response behaviors, such as licking the paws. Of particular interest is the study of social behaviors in autism models of mice. This is done by comparing the amount of time that a subject mouse spends with a stranger mouse versus the amount of time it spends on its own. Behavioral evaluation is vital when using animals to study human illnesses that include both behavioral and biological components. Therefore, the use and eventual perfection of this technique will contribute to the knowledge of animal behavior analysis and the way this behavior is demonstrated in humans.

116.
KETOGENIC DIET FOR CANINE SEIZURES: A CASE STUDY
Hannah R. Reichert '17, Natalie R. Freedgood '18
Faculty Sponsor: Susan A. Masino

Epilepsy is one of the most common neurological disorders in humans and canines. For at least 30% of those diagnosed with epilepsy current drugs are ineffective; some seizures do not respond to these medications and/or cause serious side effects. Often patients and caregivers, including dog owners, must consider other treatments. One option is the high-fat, low-carbohydrate, and adequate-protein ketogenic diet. This metabolic therapy forces the body to use ketones for fuel rather than glucose. The ketogenic diet has been used since 1921 to treat epilepsy and it can stop seizures when drugs are ineffective. This case study details the benefits of a homemade ketogenic diet prepared for a dog suffering uncontrolled epileptic seizures. The dog experienced fewer seizures eating a homemade ketogenic diet than when administered antiepileptic drugs – at some points experiencing a complete cessation of seizures. The ketogenic diet should be considered as a treatment option for dogs with seizures.

117.
THE EFFECTS OF KETOGENIC DIET ON APOMORPHINE-INDUCED STEREOTYPED MOTOR BEHAVIOR IN MICE
Lillian Russo-Savage '18
Faculty Sponsors: David Ruskin, Susan Masino

The ketogenic diet (KD) has been implicated as a method of reducing repetitive behaviors expressed by different models of autism in mice. Dopamine receptor agonists have also been used to induce repetitive behaviors in mice. In addition, it has been demonstrated that KD increases adenosine levels in the brain, which is known to have an antagonistic relationship with dopamine. The present study explores the possibility KD could decrease repetitive behaviors induced by the dopamine receptor agonist apomorphine in different mouse strains. Four different mouse strains (C57 wild-type, C57 adenosine receptor 1 knockout, BTBR, and EL) known to express different levels of stereotyped autism motor behaviors were placed on either a control diet or KD for 3 weeks before behavior testing. After habituation to the test apparatus and 10 minutes of baseline filming, the mice were injected with apomorphine (3.0 mg/kg), and filmed for another hour. Roughly 80 mice have been filmed; roughly half of the videos have been scored, therefore we can draw only preliminary conclusions at this stage. Stereotyped behavior was induced in all mice. However, from the data collected thus far, an unexpected trend has appeared with KD feeding producing opposite effects in males and females. Not enough data has been collected to comment on any strain differences. Video scoring will continue and additional animals injected and filmed over the summer.

118.
THE ROLE OF EMPATHY, CLINICAL TRAITS, AND EYE GAZE IN CONTAGIOUS YAWNING AND ITCHING
Taylor Sorensen '17
Faculty Sponsor: Molly Helt

Contagious yawning is observed more frequently in individuals with high levels of empathy (Helt, in prep), and less frequently in individuals with Autism Spectrum Disorder (ASD) (Helt et al., 2010) or high levels of psychopathic traits (Rundle et al., 2015). Contagious itching has been found to be unrelated to empathy and unaffected, indeed magnified, in individuals with ASD (Helt, in prep). The present study explores the extent to which susceptibility to contagious yawning and itching may be differentially mediated by eye contact in individuals with high and low levels of ASD and psychopathic traits in a non-clinical population. Specifically, individuals were presented stimuli of individuals yawning or itching on an ASL desktop eye tracking system. Participants eye movements were tracked and the analyzed for time, and percent of time fixated on the eyes of the people in the stimuli videos. Participants were administered the Interpersonal Reactivity Index, a multidimensional assessment of empathy, the Autism Spectrum Quotient (Baron-Cohen, et al. 2001) and The Psychopathy Personality Inventory Revised (Lillienfield et al., 2005). Eye contact to target (eyes in stimuli videos), empathy, and low levels of psychopathic traits were found to be positive predictors of contagious yawning but not contagious itching. Contagious itching was predicted by cold-heartedness, (a subscale of the PPIR) and sensory based issues (a sub scale of the Adult/Adolescent Sensory Processing Disorder Checklist). Furthermore, the tendency to contagiously yawn was mediated by eye contact to the target in the group with high ASQ traits, but not in the group with high PPIR traits. The author discusses the possibility that when

individuals with high levels of autistic traits yawn less it is due to avoidance of eye contact. In contrast, when individuals with high levels of psychopathic traits do not yawn it is due to a lack of emotional empathy.

119.
NEURAL RESPONSES TO FOOD CUES AND FOOD RECEIPT IN PRE AND POSTOPERATIVE BARIATRIC SURGERY PATIENTS
Jessica Stowell '17
Faculty Sponsors: Dan Lloyd, Sabin Khadka, Godfrey Pearlson

As the prevalence of worldwide obesity continues to increase, it has become more important to study the brain's role in obesity. Research has suggested reward system dysfunctions may be a major contributing factor to the onset of obesity. To examine the brain changes that occur when one is obese, we analyzed neural responses to food cues and food receipt in bariatric surgery patients and lean controls in this fMRI study. Patients' pre and post-surgical fMRI data were compared, and total body weight loss (TBWL) was recorded following surgery. We found differences in neural responses to both food consumption and anticipated consumption between the two groups throughout many brain regions. Additionally, we found that patients' neural responses to these conditions changed significantly one year after surgery. Our data also showed a correlation between patients' TBWL and baseline activation of the left cingulate gyrus and right insula, as well as a correlation between TBWL and change in activation (baseline to one year) within the left insula, left postcentral gyrus, and left parahippocampal gyrus. The results of our study may help better predict the most successful candidates for bariatric surgery and overall improve our understanding of the brain's role in obesity.

120.
STUDY OF PERCEPTION OF THE SEXES BY THE SEXES
Nadine Taghian '17, Naty Bush '19, Camisha Vilme '19
Faculty Sponsor: Dan Lloyd

The purpose of this study was to determine how men and women's neurological activity differed when viewing videos of male and female adults and children. We specifically wanted to analyze the emotional differences between the sexes in response to these videos. Applying data from the Human Connectome Project, we used Independent Component Analysis (ICA) to study the fMRI data of 70 subjects (42 females) as they watched videos of various themes. The results indicate that the cerebellum is activated more in males' than in females' brains when viewing images of women, and that the inferior parietal lobule is activated more in females' than in males' brains. Males' brains were more activated when viewing images of men in the posterior cingulate cortex, and females' brains were more activated in the medial frontal gyrus when viewing images of male children. Future research will focus on fluctuations in brain activity over the course of the videos to identify more distinctions.

121.
REHABILITATION OF EXECUTIVE FUNCTIONING IN PATIENTS WITH MILD COGNTIVE IMPAIRMENT WITH GOAL MANAGEMENT TRAINING
Hillary Vossler '17
Faculty Sponsor: Sarah A. Raskin

This study investigated Goal Management Training (GMT) to alleviate the symptoms of people diagnosed with mild cognitive impairment (MCI). GMT is an executive functioning intervention based on theories of goal processing and sustained attention. The objective of GMT is to teach patients to stop repeated behaviors in order to define goal hierarchies and track their performance. GMT is complemented by mindfulness meditation, which develops the skill of bringing one's mind to the present to observe behavior and goals. Four participants diagnosed with MCI were enrolled in the study. They attended two hours of training per week for ten weeks. Participants were assigned to the experimental group or the control group. Those in the experimental group went through ten weeks of GMT plus mindfulness meditation. Those in the control group went through ten weeks of GMT without mindfulness meditation. Outcome data involved pre and post assessments using the Memory for Intentions Test (MIST), the Brief Test of Attention (BTA), and the Stroop test. Questionnaires that measure quality of life and participant satisfaction were used as well. Our hypothesis was that GMT plus mindfulness mediation will be more effective than without mindfulness meditation such that there will be significantly higher post testing scores on the outcome measures.

122.
THE USE OF FMRI AS A MEASURE OF EFFICACY OF COGNITIVE REHABILITATION IN INDIVIDUALS WITH ACQUIRED BRAIN INJURY
Jasmin Williams '17, Meaghan Race '18
Faculty Sponsors: Sarah A. Raskin, Michael Stevens, Ph.D., Olin Neuropsychiatry Research Center, Hartford, CT

Prospective memory (PM) is the ability to complete an intention. PM is impaired in people with acquired brain injury (ABI). We used a randomized controlled design to investigate behavioral and brain processing changes following PM rehabilitation in individuals with ABI. We recruited a total of 14 adult individuals with ABI and 3 healthy adults between the ages of 20-60. Six ABI individuals were administered functional magnetic resonance imaging (fMRI) and all were administered the Memory for Intentions Test (MIST), neuropsychological measures of attention, memory, executive functioning and quality of life. Participants with ABI underwent a five week protocol in Cognitive Remediation Therapy or Attention Control. Then all tests were re-administered. Our results suggest that individuals with ABI improved on BVMT-R total recall and learning and there was a trend of improvement across measures. Additionally, the dorsolateral prefrontal, inferior, superior, orbital and polar frontal cortex, posterior cingulate, superior and inferior parietal, premotor cortex, and medial temporal cortex showed increased activation after CRT.

PHYSICS

123.
COINCIDE – DIGITAL DATA ACQUISITION OF MULTI-PARTICLE EVENTS
Stephen J. DeMonico '17, Aashwin Basnet '19, Alex Bellas '20
Faculty Sponsor: David Branning

In nuclear, particle, and optical physics experiments, pairs of particles must often be detected simultaneously or "in coincidence." For instance, this technique is particularly important in the study of photons that exhibit quantum entanglement. There are many existing solutions to this problem, but their usability and functionality correlate directly with cost, leaving most outside the means of small educational labs, such as one might find here at Trinity. However, the recent explosion of inexpensive and powerful DIY electronics makes it possible to develop an all-digital coincidence counter with a low price-point and a full-featured stand-alone interface.

PSYCHOLOGY

124.
LEARN 2 LEARN: METACOGNITIVE SCHOOL-BASED INTERVENTIONS FOR TYPICALLY DEVELOPING STUDENTS AND STUDENTS WITH SPECIAL NEEDS
JiYun (Lisa) Lee '17
Faculty Sponsors: Dina Anselmi, David Reuman, Hartford Magnet Trinity College Academy

Metacognition, one of the three components of self-regulated learning, has been found to enhance student academic performance (Joseph, 2009). There is growing research that indicates the importance of metacognition for students with special needs. Traditional classroom instruction may be frustrating for these students because of their learning difficulties, which are often due to a lack of metacognitive awareness and motivational challenges (Swanson & Alexander, 1997; Wong, 1987). The present study aimed to examine the effects of two metacognitive interventions on the self-regulated learning and academic performance of 8th grade students. All intervention sessions were designed to enrich metacognitive skills and developed based on Ambrose et al.'s (2010) model of metacognition. One block with a high concentration of students with special needs received a modified intervention while other blocks received the regular intervention. Students' levels of metacognition, motivation and cognition were measured with pre- and post- assessments along with quarterly grades. Contrary to prediction, there was no significant intervention effect on student metacognition. Other significant findings will be presented.

125.
THE OREGON TRAIL: A THINK-ALOUD ASSESSMENT OF METACOGNITION IN 8TH GRADE STUDENTS
Annabelle Regalado '17
Faculty Sponsors: Dina Anselmi, David Reuman

Metacognition, the awareness of one's own learning, can be divided into five distinct steps (Ambrose et al., 2010). Moreover, metacognition can be measured through offline (from retrospective self-report questionnaires) or online assessments (asking students to explain their

decision making during a problem solving task, called "think-aloud"). The current study assessed the effectiveness of *The Oregon Trail* think-aloud assessment to measure metacognition, in comparison to a self-report measure of metacognition, the Metacognition Five (MC5). *The Oregon Trail*, which is metacognitive in nature, is a videogame designed to teach students about the journey of the pioneers and the obstacles they faced during the era of Westward Expansion in the United States during the 19th century. The students play the game as the wagon leader that tries to successfully take his or her party from Independence, Missouri to Oregon. Of additional interest was whether there was a relationship between academic grades and performance on *The Oregon Trail* task. Participants played the game for twenty minutes as the researcher tallied their game play behavior and asked them to explain their reasoning behind key game play decisions. Both behavioral tallies and coded statements from the think-aloud procedure were positively correlated with academic performance and with scores on the MC5 measures. Due to the small sample size (n=15) these correlations were not statistically significant but were in the predicted direction. The study demonstrated the potential usefulness of online assessments of metacognition.

126.
LEARN 2 LEARN: ENRICHING STUDENT SUCCESS THROUGH METACOGNITIVE SCHOOL-BASED INTERVENTION: A LONGITUDINAL FOLLOW UP OF MIDDLE SCHOOL STUDENTS IN HIGH SCHOOL
Katelyn Elinoff '17
Faculty Sponsors: Dina Anselmi, David Reuman

Metacognition is the awareness and regulation of one's thought process and learning style, often correlated with self-directed learning, increased academic performance, and motivation (Dignath & Buttner, 2008). Enabling students to be aware of their own cognitive processes through activities such as planning and monitoring their progress are metacognitive in nature and research suggests these strategies can help students become more successful in the classroom (Ambrose et al., 2010). The present study explored the metacognition and motivation of current 9th and 10th grade students, some of whom were part of a metacognition intervention when they were in 8th grade. Two questions were the focus of the study. First, was there a difference in metacognition and motivation between students in 9th and 10th grade? A cross sectional analysis demonstrated no significant differences between the current 9th and 10th grade students' metacognition and various motivational measures. A second question using a longitudinal analysis was whether students who were exposed to the metacognition intervention in 8th grade showed any significant carry-over effect in 9th or 10th grade. Although there was no long-term effect of 8th grade intervention, the longitudinal analysis showed that metacognition declined from 8th grade to high school and this was mostly attributable to the decline in the "Reflect and Adjust" step of the metacognition cycle.

127.
LEARN 2 LEARN: DEVELOPMENTAL DIFFERENCES IN MOTIVATION AND METACOGNITION
Evan Scollard '17
Faculty Sponsors: Dina Anselmi, David Reuman

Self-Regulated Learning (SRL) refers to one's ability to remain aware and consciously in control of one's learning processes, thereby maximizing learning potential. This ability to self-regulate one's learning is more specifically reliant on the interaction between one's cognition, motivation,

and metacognition (Butler & Winnie, 1995). This study focused specifically on metacognition and motivation, which have both been correlated positively with academic achievement (Young & Fry, 2008, Mega, Ronconi & de Beni, 2014). While the is significant research to show that metacognitive ability increases into adulthood and then plateaus. A few studies indicate that metacognitive ability may actually decrease during adolescence. One reason may be due to a decrease in motivation. Sixth, seventh, eighth graders from a magnet school in Hartford, Connecticut were given interactive lessons that were designed to enhance their metacognitive abilities. An approximately equal number of students from the three grades were placed in a control condition where they received instruction on different types of transitions to either high school or college. Changes in students' metacognitive ability, motivation, academic achievement were measured by pre-intervention and post-intervention quantitative surveys, quarterly grades, and teacher assessments. Results supported the claim that metacognition and motivation decline in adolescence. While the metacognitive intervention did not significantly raise the metacognitive abilities of any of the three grade levels, metacognitive ability did decline significantly between sixth and seventh grade, remaining low through the eighth grade. Similarly, motivation declined by grade level. Results suggest that students become less motivated during adolescence and their metacognitive performance suffers.

128.
THE EFFECT OF BILINGUALISM ON SOCIAL COMPETENCE AND ACADEMIC SUCCESS
Olivia Curreri '19, Hannah Oganeku '18, David Kang '17, Evan Scollard '17
Faculty Sponsor: Dina Anselmi

The purpose of this study was to examine how bilingualism influences a student's college experience both academically and socially. We investigated if there were any advantages or disadvantages to being a bilingual student in college and how any differences influenced students' academic performance. We hypothesized that bilingual college students, regardless of their primary language, would show higher levels of social competence than monolingual students. We also predicted that bilingual college students would show higher levels of academic success than monolingual students. To test these hypotheses, we sent a survey via email to a random sample of approximately 450 Trinity College students that included questions to measure bilingualism and language ability, as well as various aspects of social competence. Results from 128 participants, 82 of whom were labeled as bilingual, showed a positive correlation between the level of language ability and social competence, supporting our hypothesis. However, the results did not show a significant relationship between students' language ability and their academic success, as measured by their GPA; therefore not supporting our second hypothesis.

129.
THE RELATIONSHIP BETWEEN GENDER ROLE CLASSIFICATION AND SEXUAL PROMISCUITY IN TRINITY COLLEGE STUDENTS
Samantha Beati '17, Caroline Howell '18, Eliza Marsh '18, Deane Pless '17
Faculty Sponsor: Dina Anselmi

Promiscuity among students on college campuses has become a major problem throughout the United States due to its negative effects on physical and mental health. The purpose of this study was to see if there is a relationship between an individual's gender role classification and their

sexual promiscuity on Trinity College's campus. A 76-item questionnaire was sent out to 400 Trinity students. The questionnaire featured questions from the BEM sex role inventory to assess each participant's gender role classification and the socio-sexual orientation inventory (SOI-R) to assess the sexual promiscuity of participants.

Based on the 69 responses (26 males, 43 females), we found that there was a significant effect of gender role classification on sexual promiscuity for male students, but not for female students. The mean promiscuity score for males who score as highly masculine was significantly greater than the mean promiscuity score for males who score as highly feminine. However, the males who were scored as androgynous did not significantly differ from the males who scored high in masculinity or high in femininity. Our findings show that, in general, males who report a high degree of masculinity were the most sexually promiscuous. Because our study is correlational in nature, we cannot determine whether notions of masculinity lead to certain sexual behaviors or whether engaging in promiscuous sexual behaviors increase one's sense of maleness. Probably both relationships are at play since there is ample evidence that notions of masculinity are deeply rooted in the phenomenon of "hooking-up" on most college campuses.

130.
THE ROLE OF FAMILY DYNAMICS IN A PREVENTION INTERVENTION STUDY FOR CHILDHOOD ANXIETY
Ali Chalfin '17
Faculty Sponsors: Laura Holt, Molly Helt, Dr. Jeffrey Pella, Dr. Golda Ginsburg, UConn Health

Anxiety Disorders (ADs) are the most common mental health issue affecting children today. Anxiety is highly heritable, thus making the study of its transmission from parent to child critical. There are few existing family-focused interventions aimed at preventing childhood anxiety; one such intervention called the Coping and Promoting Strength Program (CAPS) conducted at JHMI, has showed promising preliminary effects in preventing childhood anxiety. However, there are still numerous unanswered questions regarding how this intervention worked. I explored the role of family dynamics and the participants' responses to the intervention using the Children's Perception Interparental Conflict (CPIC) and the CAPS Impact scale, among other measures. And, how this is reflected in their responses to the questions on the CPIC and their responses to the CAPS Impact scale about knowledge acquired through the intervention. There were four main hypotheses for this study. First, parents in the CAPS intervention group will experience a larger reduction in anxiety symptoms, compared to the Information Monitoring group. Secondly, parents in the CAPS intervention group will experience a larger reduction in inter-parental conflict, compared to the Information Monitoring group. Thirdly, the decline in parental anxiety symptoms will be significantly associated with decline in inter-parental conflict. Lastly, the CAPS Impact Scale will show that parents learned and retained more information about symptoms of anxiety with each evaluation. Statistical tests were conducted for each of these hypotheses. Preliminary results show that there is significance over the course of the study, for some of the hypotheses, but no significant difference between treatment groups

131.
THE RELATIONSHIP BETWEEN MINDFULNESS MEDITATION, STRESS, AND EMPATHY
Nicole Desrosier '17
Faculty Sponsors: Randolph Lee, Sarah A. Raskin

This study explored the interaction between meditation, stress, and empathetic capacities, addressing three hypotheses: (1) Individuals with greater cumulative life stress will have lower empathetic abilities, (2) independent of cumulative life stress, participants assigned to the music listening group will become more stressed when listening to the stressful life event recording compared to participants in the meditation group, (3) participants in the meditation group with low empathetic abilities will not benefit as much from the meditation intervention compared with participants with high empathetic abilities. 50 participants, recruited from the Trinity College community, were first asked to complete the Stress and Adversity Index, the Interpersonal Reactivity Index, and the Scene Construction Questionnaire. Participants were then placed in the meditation group or the music-listening group (active control). After the interview phase, participants returned for the laboratory session where baseline levels of salivary alpha-amylase, galvanic skin response, and heart rate were obtained. Once these levels were established, participants meditated or listened to *Weightless* by Macaroni Union for 20 minutes. After 20 minutes, the participant's pre-recorded stress script was immediately played for them, which was developed from the Scene Construction Questionnaire. The results of the study partially supported the first and third hypothesis, while the second was not supported at all. In summary, this study provided some evidence that cumulative life stress may impact empathetic ability and that empathy could influence an individual's baseline ability to meditate. Additional studies are necessary to determine the strength of these relationships, and to further investigate the effect of *Weightless* on relaxation in comparison to meditation and other forms of music known to reduce stress.

132.
THE EFFECT OF A SINGLE MOTHERS' MARITAL STATUS ON SYMPATHY, CHARACTER EVALUATIONS AND MATERNITY LEAVE SUPPORT
Patrick Dorsey '17
Faculty Sponsor: Robert Outten

Social science research has found that single mothers are viewed more negatively than married mothers. We hypothesized that never married single mothers would garner less sympathy, less favorable character evaluations and people would be less willing to support maternity leave policies compared to formerly married single mothers (i.e., widowed and divorced). Conditions varied by marital status; either Maya was never married, divorced or widowed. Afterwards, participants completed measures of sympathy toward Maya, character evaluations of Maya, and rated their endorsement of maternity leave policies. Participants assigned to the never married condition expressed significantly less sympathy, perceived Maya as significantly less hardworking, significantly more irresponsible, and significantly more promiscuous. We also examined if sympathy mediated the effect of marital status (previously married: divorced and widowed vs. never married) on character traits and maternity leave policies. People evaluated Maya more positively and supported maternity leave policies more when she was previously married, compared to when she had never been married, because they felt more sympathy.

133.
CULTURAL DIFFERENCES AND THE INFLUENCE OF PARENTING STYLES ON TRINITY COLLEGE STUDENTS' ATTITUDES TOWARDS UNCOMMITTED SEX
Olivia Godfrey '18, Hayley Pappas '17, Fernando Cuervo-Torello '17, Elizabeth Stepanek '17
Faculty Sponsor: Dina Anselmi

The purpose of this study was to examine whether certain parenting styles employed when growing up, specifically permissive, authoritarian, and authoritative styles, had an influence on Trinity College students' attitudes towards uncommitted sex and whether these effects varied across gender, school year, and ethnicity. Our first hypothesis was that students who grew up with permissive parenting styles would be more likely to have favorable attitudes toward uncommitted sex, students who grew up with authoritarian parenting styles would be more likely to have strict attitudes toward uncommitted sex, and students who grew up with authoritative parenting styles would be more likely to have ambivalent attitudes towards uncommitted sex. The hypotheses for the cultural variables included: males are more likely to have more favorable attitudes toward uncommitted sex than females; females are more likely to perceive their parents as being authoritarian compared to how males perceive their parents; upper class students are likely to have more favorable attitudes toward uncommitted sex than first year students. We distributed an online questionnaire to a random sample of 300 Trinity College students, 150 first year students and 150 upper class students. We received 89 responses. The questionnaire included the Attitudes Toward Uncommitted Sex Scale (Owen, Rhoades, Stanley & Fincham, 2007) and the Parental Authority Questionnaire (Buri, 1991). The results showed there were no significant correlations between parenting styles and attitudes toward uncommitted sex. When looking at other variables such as gender, school year, and ethnicity, we found significant results in some areas. Males were more likely to agree with the statements that supported uncommitted sex, while females were more likely to disagree with the statements that supported uncommitted sex. In addition, we found that females are more likely to perceive their parents as being authoritarian compared to how males perceive their parents. Finally, we found that upper class students are likely to have more favorable attitudes towards uncommitted sex than first year students. All other variables were found to be not significant.

134.
THE CORRELATION BETWEEN INVOLVEMENT AND SATISFACTION AT TRINITY COLLEGE
Emily Kaufman '18, Erica Merullo '18, Aubree Udell '18, Andi Nicholson '17
Faculty Sponsor: Dina Anselmi

Our study investigated the relationship between campus involvement and satisfaction at Trinity College. Two questions motivated our research. Is there a relationship between student satisfaction and student involvement? Second, are there certain groups or subgroups that report more or less satisfaction at Trinity College? We hypothesized that athletic and/or Greek life involvement at Trinity College will lead to the greatest level of satisfaction in comparison to other groups, since these organizations require more dedication and commitment, and may foster greater community belonging and long lasting relationships. We distributed an online survey to a random sample of 300 Trinity students. We measured participant's levels of satisfaction within each activity that they were involved in on campus, as well as other aspects of their satisfaction at Trinity. Results from 64 students showed no significant correlation between Greek life involvement and

satisfaction at Trinity College. There was, however, a significant correlation between a participant's athletic involvement and their satisfaction at Trinity College as well as the community satisfaction at Trinity College. Also, there was a marginally significant correlation between athletic involvement and social life satisfaction at Trinity College.

135.
THE INTERPLAY BETWEEN GENDER IDEOLOGY, GENDER IDENTITY, AND DISTINCTIVENESS THREAT IN CISGENDER WOMEN'S EMOTIONAL RESPONSES TOWARD TRANS WOMEN'S ACCEPTENCE INTO WOMEN'S COLLEGES

Marcella E. Lawrence '17
Faculty Sponsor: Robert Outten

Cisgender women either read about a women's college that admitted or denied trans women. This manipulation allowed us to test a moderated-mediation model whereby the indirect effect of admitting trans women to a women's college on negative feelings toward trans women (i.e., heightened anger and fear; decreased sympathy) would be mediated by distinctiveness threat. We expected adherence to a liberal feminist gender ideology and gender identification to moderate this indirect effect; such that cisgender women low in liberal feminist ideals and high in gender identification would express greater negative feelings when trans women were admitted via distinctiveness threat. Distinctiveness threat did not mediate the effect of condition on emotions. However, gender ideology moderated the direct effect of condition on fear. Participants low in liberal feminist ideals expressed significantly greater fear in the admission condition. We discuss these findings in relation to the debate surrounding including trans women in women-only spaces.

136.
USING LITERACY TO SHIFT ATTITUDES AND BEHAVIORS FOR CHILDREN WITH INCARCERATED PARENTS

Jade Lee '17
Faculty Sponsors: Dina Anselmi, Laura Holt, Joy Haenlien & Landon Osborn, Connecting Through Literacy: Incarcerated Parents and Their Children

Incarceration and low literacy play a key role in perpetuating the long-standing, systematic oppression of minority and low income communities. School- and community-based programs have been developed to address literacy concerns in this population; however, few studies have described the experiences of program participants in depth. The purpose of the current study was to examine the CLICC (Connecting Through Literacy: Incarcerated Parents, Children, and Caregivers) program, which is aimed at reducing recidivism rates by utilizing literacy to build stronger relationships between incarcerated parents and their children. Twelve program participants, ages 7-16, were surveyed via semi-structured interviews on perceived psychological closeness to their incarcerated parent(s) and self-reported attitudes and behaviors towards literacy. Seven children entering the program were compared to four children phasing out. Qualitative and quantitative assessments revealed significant heterogeneity in participants' experiences with literacy and parental relationships. The diversity of participants and the small sample size precluded statistical comparisons between the two groups, but the data revealed valuable insights on a population that has received limited attention in the literature.

137.

SPEED-ACCURACY TRADE-OFF IN VALUE-DRIVEN ATTENTIONAL CAPTURE
Yuxuan Li '17
Faculty Sponsor: Michael A. Grubb

Attention is traditionally divided into two types: voluntary, goal-directed attention and involuntary, stimulus-driven attention (Corbetta & Shulman, 2002; Theeuwes, 2010). However, seminal work on value-driven attentional capture (VDAC) has shown that stimuli associated with reward during a reward learning phase slowed reaction time (RT) in a test phase even when task-irrelevant and non-salient (Anderson, Laurent, & Yantis, 2011). Slower RT, however, can also indicate a preference for more accurate responses at the expense of speedy ones (Wickelgren, 1977) rather than an attentional shift. Performance-contingent reward and a response deadline of 800ms impose additional constraints in the VDAC paradigm: responding too quickly decreases reward likelihood and responding too late drops the reward probability to zero. Thus, to maximize reward, participants must carefully decide when to respond, potentially altering the strategic balancing of speed and accuracy and confounding attentional effects with decisional ones. We replicated the VDAC paradigm to address the influence of different response strategies, directly comparing an experimental group (trial-by-trial reward, n=24) and a control group (flat reward, n=24). Analysis includes only the baseline trials without previously rewarded distractors in the test phase. Using maximum likelihood estimation, RT distributions were fitted with an exGaussian model containing three parameters: μ, mean of the Gaussian component; σ, standard deviation of the Gaussian component; and τ, rate of the exponential component. We found that RT variability (σ) was significantly greater in the experimental group ($p<0.05$), suggesting that reward learning produced a less stable strategy. Further, RT variability positively correlated with error rate ($r=0.51$, $p<0.001$), reflecting a behavioral cost with greater RT variability. These results call into question the validity of the baseline trials used in the VDAC paradigm, as reward learning altered the responding strategy even after reward was removed.

138.

PURSUED FOR THEIR PRESCRIPTION: COLLEGE STUDENTS WITH ADHD APPROACHED FOR THEIR STIMULANT MEDICATIONS
Paige Marut '17
Faculty Sponsor: Laura Holt

More than 92% of college students with ADHD report they have been asked by peers to give away or sell their stimulant medication (Schultz et al., 2017). Being approached for their stimulants puts these students at risk for engaging in *diversion*, or the transfer of licit prescription drugs to illicit, unauthorized uses. There is little knowledge as to *how* students are asked by others to give away/sell their medication or whether they feel pressured to engage in diversion as a response to these requests. In this study, I investigated predictors of past-year diversion, prescribed students' exposure to certain types of peer requests for medication, and the extent to which these students have felt pressured to engage in diversion. 67 Trinity students with self-reported ADHD and stimulant prescriptions completed a web-based survey assessing past-year diversion activity, attitudes towards diversion and non-medical use of prescription stimulants (NMUPS), and previous exposure to types of requests for their medication. Additionally, 15 students participated in follow-up interviews where they were asked about their experiences being approached for their medication. 55% of prescribed students were found to have engaged in past-year diversion.

Diversion was more likely among seniors, Greek members, stimulant misusers, and students approached for their medication. Data from surveys and interviews suggested students had been approached in a variety of ways for their medication, with the most common type of request being rationality with academic justifications. A significant number of students reported feeling pressured to divert their medication, and diverters were more likely to report feeling pressured than non-diverters. In conclusion, college students with ADHD frequently asked by peers to divert their medication, and many feel pressured to do so. Future research should examine what makes for "effective" diversion refusal messages for different types requests to inform the design of potential interventions.

139.
COOPERATION VIA COMMUNICATION: INFLUENCING VOCAL ALIGNMENT IN CONVERSATION

Elliot Pollack '17
Faculty Sponsor: Elizabeth Casserly

Alignment of human behavior is a well-documented phenomenon, however, the factors which influence its direction and magnitude are not firmly established. Conversational partners align on a variety of speech factors including word choice, syntax, and rate of speech. The present study examines factors which lead to alignment of fundamental frequency (F0), colloquially known as pitch. Subjects (Speakers) complete a puzzle task which requires them to communicate with a partner (Model). The Model's F0 is manipulated to either converge towards or diverge from that of the Speaker, whereas a control condition does not change the Model voice. The Speaker is recorded throughout the interaction (Task); baseline (Pre-task) and final (Post-task) recordings are also taken. Speakers' F0 is measured at each time-period to determine the direction and magnitude of alignment. In a separate session, naïve subjects (Listeners) assess the similarity between the Speaker's speech over time and the Model. A personality survey examines which factors serve as reliable predictors of alignment. Speakers are found to deviate from the Model in F0 during the interaction, however, are perceived by Listeners to mimic the Model over time in a holistic measure. These findings are consistent regardless of the Model's direction of alignment. Speakers are rated as becoming more like the Model when this partner diverges as opposed to converges. The personality factor survey shows that Openness predicts alignment. Specifically, greater Openness predicts less perceived similarity. None of the other personality factors (conscientiousness, extraversion, agreeableness, neuroticism) are found to share a significant relationship with alignment behavior. Alignment between any two time-periods throughout the experiment predicts alignment with the third. The discrepancy between Speakers' divergence in the acoustic measure and their rated convergence in the perceptual measure reveals a potential hierarchy of speech factors that we use to assess alignment.

140.
STEREOTYPES OF LEARNING DISABILITIES ON COLLEGE CAMPUSES

America Richmond '18, Charlotte DeLana '18, Dong Young Lee '17, Esme Douglas '18
Faculty Sponsor: Dina Anselmi

The purpose of this study was to examine if stereotypes against learning disabilities (LD) exist among college students. Secondly we were interested in seeing if there were differences in stereotypes held between individuals with and without LDs, as well as, between individuals with

and without a friend or family member with a LD. We hypothesized that individuals with LD would hold fewer negative stereotypes of LD than those who do not have LD. Moreover, we hypothesized that individuals with a friend or family who has LD would have less negative stereotypes of LD than people who do not have a friend or family with LD. We distributed an online survey to 300 randomly selected students (75 students from each class). Participants were given the Learning Disability Stigma Measure that we created based on the Stigma Consciousness Questionnaire - Learning Disabilities (SCQ-LD) (Dalay & Johnston, 2016) to measure their levels of stereotypes of LD. Results from 52 Trinity College students showed no significant differences in attitudes about LD between individuals with and without LD. Furthermore, there was no significant difference in stereotyped attitudes between people who have a close friend or family member with a LD versus people who do not have a close friend or family member with an LD.

141.
COOPERATION VIA COMMUNICATION: ACOUSTICS OF SPEECH PRODUCED DURING A PUZZLE TASK
Rachel Scheub '20, Anneliese Pedro '20
Faculty Sponsor: Elizabeth D. Casserly

Humans have a tendency to automatically align both their behavior and their speech. This research project examined the alignment of speakers during a remote conversational task where the experimenter's participation was secretly pre-recorded. The experimenter's voice was presented in one of three conditions: converging towards the speaker's voice, diverging away, or remaining neutral. Pre-task, task, and post-task recordings of the participants' speech were sampled for each of these three experimental groups. These recordings were compared to the experimenter's voice to measure each participant's convergence or divergence. An acoustic analysis of f0 (vocal pitch) was conducted using the program Praat which conducted spectral analysis of the participants' speech. The acoustic analysis yielded slightly unexpected results. The majority of the participants appeared to diverge in pitch from the experimenter's voice. The data also suggested that the researcher's convergence/divergence had an impact on speakers' pitch, but the overall divergence is unusual for two reasons: First, because previous studies of f0 have shown convergence; and second, because an experiment with listeners' perceptual judgments on our same speakers did show convergence. These results therefore emphasize that many factors determine speech production outcomes, and analysis of a single feature of speech such as pitch is insufficient to make conclusions about convergence and divergence of speech. Future work may examine whether a lower initial experimenter pitch has an impact on the likeliness that a participant will converge.

142.
AGGRESSION AND DEPRESSION FACTORS IN PORNOGRAPHY USE OF COLLEGE AGED INDIVIDUALS
Brandon A. Scott '18, IDP
Faculty Sponsor: Jason A. Gockel

After multiple legal, cultural and technological changes, pornography's accessibility and role in modern western culture has expanded exponentially (Kammeyer, 2008). For this reason, we wished to examine the possible correlates of specific emotions to pornography use and the perceived effects of pornography use in college aged male and female participants. Current

literature shows male pornography use has a higher frequency than female pornography use (Weaver et. al, 2011). Though much of the research on aggression correlates to pornography use concentrates on male pornography use, the research examining female pornography use and aggression seem to show similar patterns between genders (Wright, Tokunaga, & Kraus, 2016). Where heightened aggression may be a direct societal risk, heightened depression from a higher use of pornography can be seen as both an indirect societal risk as well as a direct personal risk. For this reason, we also examined the correlations between depression and heightened pornography use, which in past studies has been shown to be positively correlated (Weaver et al., 2011). Participants in our study were Trinity College students, randomly selected by the Trinity College Institutional Review Board ($N = 47$) who were asked to fill out an anonymous email survey on the relationship between pornography and emotions. As expected, male participants showed a significantly higher frequency of pornography usage. Our initial analysis using the Beck Depression Inventory and the Aggression Questionnaire (Buss & Perry, 1992) to analyze aggression and depression correlates showed no significant relationship to frequency of pornography use for the overall group or when the group was separated by gender. A significant relationship was found for the relationship between male pornography use and perceived depression post use as well as both female perceived depression post use and female perceived aggression post use in relation to frequency of use.