Abstracts

Astronomy & Astrophysics

A-01: The secret lives of Cepheids: monitoring period and amplitude changes in classical Cepheids
Author: Mary Erickson
Advisor: Dr. Scott Engle

Cepheid Variable Stars, which are located on the Instability Strip of the Hertzsprung-Russel Diagram, can be used as a "standard candle" distance marker (Fiorentino 2007). Their use as a standard candle came about as a result of the discovery of the Period-Luminosity Relationship, and they have since been used to calculate distances to father away objects as well as calculate more accurate means of finding distances (i.e. the Hubble Constant). Cepheids will cross the Instability Strip, either in a "redward" or "blueward" direction depending on the stage in which the Cepheid is evolving (Neilson 2012). While Cepheids were originally believed to have regular periods, varying periods in Cepheids have been noticed, dating back to Eddington in 1919. Therefore, Cepheids must be closely monitored in order to deduce where these period variations are coming from – either from inside the star itself or from some outside source. In this paper, data was taken for two Cepheids from two different sources and then compared. The Cepheids in question are AA Gem and BB Gem, both located in the Gemini constellation. Data for these two stars was taken from the All Sky Automated Survey (ASAS) and from the Robotically Controlled Telescope (RCT) in Kitt Peak. The ASAS constantly observes stars "brighter than 14 magnitudes and 10^7 mass". They are constantly looking for "any photometric variability" (Astrouw), which makes them a perfect source for obtaining Cepheid data. The RCT telescope is located in Kitt Peak and can be operated remotely from Villanova University. The telescopes from which data was obtained are isolated and very sensitive, which leads to as accurate a data sample as possible. Multiaperture photometry was applied to the images of AA Gem and BB Gem in Astroimagej, which generated plots of the different seasons. The data was then separated into different seasons, and light curves of the individual seasons were made in Kephem. These results were then analyzed in order to find changes in the periods of AA Gem and BB Gem since they were recorded in the Szabados papers of the late 1970s and 1980s.

A-02: Origin of Long-duration Gamma-ray Flares and Their Connection with SEPs
Authors: Valerie Bernstein, Dr. Lisa Winter, and Edward Cliver
Advisor: Dr. Lisa Winter

The mechanism producing long-duration solar gamma-ray events (LDGREs) is unresolved. Such events are characterized by high-energy (>100 MeV) pion-decay emission that can be detected for up to 10 hours after the flare impulsive phase. Candidate processes include: (1) prolonged acceleration/trapping of high-energy (> 300 MeV) protons in flare loops and (2) precipitation of energetic protons to the Sun's surface from the CME-driven coronal shock waves. Proton events offer the opportunity to examine particle acceleration mechanisms associated with solar activity, and they are important because they pose radiation hazards to spacecraft and astronauts and disrupt ionospheric communications. LDGREs, or events with delayed/prolonged pion-dominated emission, have been detected by the SMM GRS, GRO EGRET, and Fermi LAT. To gain insight on their origin,

we examine associated GOES X-ray bursts, LASCO CMEs, Wind Waves low-frequency radio bursts, and GOES high-energy proton events, and compare the properties of these various phenomena with the intensities and durations of the observed LDGREs.

A-03: Discovering Cepheid and RR Lyrae stars: Pan-STARRS Science Archive and robotically controlled telescopes
Author: Elizabeth Johnson
Advisor: Dr. Scott Engle

Cepheid and RR Lyrae stars are an integral part of the cosmic distance ladder and are also useful for studying galactic structure and stellar ages. This project aims to greatly expand the number of known Cepheid and RR Lyrae stars in our galaxy through use of the PanSTARRS-1 3pi catalog and robotically controlled telescopes. Candidate targets are selected from the cataloged stars based on color and variability index. Then the candidates are fully vetted using robotic telescopes: the RCT 1.3 meter (Arizona) and RATIR 1.5 meter (Mexico). Here I present my work done this summer to develop a full, semi-automated prescription from candidate selection, to targeted follow-up photometry, to cataloging and classification. The goal, through continued observation and analysis into the fall, is to identify at least 10,000 new variables, hundreds of which will be new Cepheid and RR Lyrae stars.

A-04: The search for evidence of a Proxima b transit: long term photometry of Proxima Centauri
Author: Lucas Marchioni
Advisor: Dr. Edward Guinan

In light of the recent discovery of Proxima b and its potential habitability, it is possible to carry out transit photometry to detect Proxima b provided its orientation allows for transit observation from the vantage point of Earth. Proxima b is known to be approximately 4.8 Gyr old from its relationship with the Alpha Centauri AB star system (Bazot et al. 2016). The Earth-sized exoplanet has also been found to have an orbital period of approximately 11 days, a mass of 1.27 Earth masses, and sits at approximately 0.0485 AU from Proxima Centauri (Anglada-Escudé et al. 2016). 10 years of available photometry of Proxima Centauri has revealed a 7.1 year starspot cycle comprising approximately 11 percent of the star's surface. The presence of a photometric transit of Proxima b, though relatively slim in probability, would reveal the orientation of the orbit of Proxima b. R filter CCD photometry was carried out on Proxima Centauri data between 2014 and 2015 originating from the Skynet Robotic Telescope Network archive. The AstroImageJ data processing system was utilized with 4 comparison stars to process the photometric data. The results showed no signs of a transit, though the data showed the presence of Proxima Centauri's 83 day period. This study was carried out with support from the NSF and NASA through NSF and NASA through grants NSF/RUI-1009903, HST-GO- 13020.001-A and Chandra Award GO2-13020X to Villanova University.

A-05: Processing data from the K2 Mission Fields C11-C13: analysis of eclipsing binaries from differentiated stellar populations
Author: Nicholas Trotta
Advisor: Dr. Andrej Prsa

The key components of modern stellar astrophysics revolve around determination of fundamental parameters of stars, such as mass, radius, age, and composition. Expanding upon the current

understanding of the shared relationships between these variables is one of the key goals of interpreting the processed data from K2. The K2 mission is the continued operation of the Kepler spacecraft after failure of the reaction wheels left the craft only able to observe in the ecliptic plane. This makes the data from K2 ideal for observing different galactic latitudes, covering intrinsically different regions of our Galaxy. In order to accomplish this, the most efficient method uses analysis of eclipsing binaries, two stars rotating around each other parallel to the plane of observation, leading to a measurable change in flux as the stars eclipse. By selecting only light curves of eclipsing binaries from the K2 mission, a set of data spanning different galactic latitudes is created, and patterns relating the location of a star system within our Galaxy to the physical attributes it displays are revealed. These systems are advantageous due to their geometry leading directly to determination of the radius with respect to the size of the mutual orbit, solely based upon the measured flux of the system over time. With 665 eclipsing binaries being measured by the K2 mission, this method is ideal for quickly and accurately determining the distribution of these basic parameters in relation to the galactic latitude of the galactic plane, which varies from -85 to 85-deg as a result of the K2 satellite orbit along the ecliptic plane. Through analysis of the light curves taken from K2, a selection of stars from these intrinsically different parts of the sky can be taken. This analysis entails analyzing the light curves of each system, and determining the portion of the period and depths of each eclipse, and following with the use of this elapsed time to determine the radius of each star relative to the size of the orbit. With this number of systems, manually setting these parameters is important in order to separate skewed data and avoid improperly characterizing any anomalous systems. Resulting trends from the data set constrain the relationships between the galactic latitude and fractional radii, as well as between eccentricity and the log period.

A-06: A far ultraviolet spectroscopic analysis of RR Pic, Di Lac, and V533 Her
Author: Liam Jones
Advisor: Dr. Edward Sion

Prior to the last 30 years, the literature on cataclysmic variables (CV's) contained little on the properties of the underlying white dwarf accreter other than estimates of their masses. However, with the advent of space spectroscopy, specifically The Far Ultraviolet Spectroscopic Explorer (FUSE), direct spectroscopic observations of exposed white dwarfs in CV's were carried out during dwarf nova quiescence or low brightness states of nova like variables. By utilizing the IRAF and Specview programs, we analyzed FUSE spectroscopic observations of the old novae old novae; RR Pictoris (Nova Pic 1925), DI Lacertae (Nova Lac 1910), and V533 Herculis (Nova Her 1963). With the IRAF and Specview software, spectral lines were identified and labeled. In addition, the line shifts and equivalent widths of the lines were measured, yielding line strengths, and eventually chemical abundances. A by analyzing the far ultraviolet spectra search for variations in the continuum flux levels in the three old novae was also carried out with a view toward determining the origin of the line features, the mix of chemical elements and their relative abundances. If the white dwarf accreter is the dominant source of F-UV flux, then the absorption line features in the accreted atmosphere can be used to probe the physics of accretion and the thermonuclear history of the old nova systems. The results of this investigation and its implications are discussed.

Biochemistry

A-07: Brd2 paralogs may act antagonistically and affect central nervous system, circulatory and excretory system development in zebrafish

Authors: Gregory Branigan, Kelly Olsen, and Dr. Angela DiBenedetto
Advisor: Dr. Angela DiBenedetto

Brd2 is a member of the bromodomain-extraterminal domain (BET) family of transcriptional co-regulators and functions as a histone-directed scaffold in chromatin modification complexes. Brd2 facilitates expression of pro-proliferation genes and helps control apoptosis in mammalian adult tissues, while the Drosophila homolog is an upstream regulator of Hox genes in development. In zebrafish, brd2 has duplicated and diverged during evolution of telosts, resulting in brd2b and brd2a paralogs with both overlapping and divergent expression patterns in developing embryos. We probed the developmental role of Brd2b through microinjections of antisense morpholino (MO) oligonucleotides and compared the morphant phenotype to that of the already characterized Brd2a paralog, which exhibits increased apoptosis and brain and central nervous system defects. Brd2b morphants show similar defects in brain but novel trunk defects. Whereas Brd2a knockdowns exhibit increased numbers of pax2a-positive cells in the peripheral blood island at 24 hpf, Brd2b knockdowns show reduced numbers of cells in this region, with heart defects and lack of circulation at later stages. Brd2b knockdowns also fail to form hollowed out pronephric ducts. Remarkably, co-knockdown of both Brd2b and Brd2b shows rescue of both brain and trunk defects, suggesting an antagonistic relationship between the paralogs. All morphant phenotypes are being verified using Crispr/Cas9 injections globally into 1 cell embryos and MO injections locally into the peripheral blood island of segmentation stage embryos, in addition to comparative phenotypic analysis of BET inhibitor- treated embryos, and of brd2b mutant lines obtained from ZIRC. Mitosis, apoptosis, and expression of blood stem cell markers are being assessed as additional phenotypic endpoints. Brd2a and 2b paralogs in zebrafish provide a unique opportunity to analyze both conserved and more recently derived functions of this important epigenetic regulator.

A-08: Trichostatin A and Brusatol's effects on Protein Levels

Author: Matthew Savage
Advisor: Dr. Aimee Eggler

Histone deacetylases (HDAC's) are proteins which are responsible for deacetylation, not only of histones, but a variety of other proteins. Acetylation is similar to phosphorylation in that both are means of regulating protein function. This work focuses on the effects that inhibiting HDAC's has on the levels of proteins that are rapidly synthesized and degraded in the cell. Our hypothesis tested here is that HDAC inhibition, i.e., the resulting acetylation, lowers global protein synthesis, perhaps by acetylation of the ribosome. If this were to be true, an extension of that hypothesis is that reactive oxygen species (ROS) are responsible for inhibiting HDACs, leading to suppression of protein synthesis. We came to these hypotheses from two observations. First, we have seen previously that MG132 (a proteasome inhibitor) -induced accumulation of three rapidly synthesized and degraded proteins--Nrf2, Hif-1α and cMyc, were all suppressed by treatment with a compound that generates ROS, suggesting a global inhibition of protein synthesis. Second, others have shown that the MG132-induced accumulation of Nrf2 is suppressed by HDAC inhibition.1 We were curious if this suppression might extend beyond Nrf2. To test our hypothesis we used the HDAC inhibitor

trichostatin A (TSA), and examined its effects on MG132-induced accumulation of Nrf2, Hif-1α and cMyc . It is currently unknown if ROS are inhibiting HDACs.

We found that TSA did significantly suppress the MG132-induced levels of Nrf2 and cMyc. Hif-1α levels appear to be suppressed by the highest concentrations of TSA tested. Lower concentrations of TSA appeared to somewhat increase Hif-1-α and cMyc levels in the presence of MG132. Finally, the small molecule brusatol was tested in the same way as TSA. In the literature, brusatol lowered Nrf2 levels in cancer cells, however, the mechanism is unknown.2 We hypothesized that similar to ROS and TSA, it would suppress global protein synthesis. Our results show that for all proteins (Nrf2, Hif-1-α, cMyc, as well as survivan), brusatol lowered protein levels, suggesting that brusatol does globally inhibit protein synthesis.

A-09: Comparison of unfolding ability of the proteasome with Keap1 and Rsp5 ubiquitinated fluorescent substrates

Authors: Mansi Mann and Maria Djogova
Advisor: Dr. Daniel Kraut

The proteasome is a protein complexes that degrades abnormal, misfolded, and regulatory proteins. Proteins to be degraded are tagged with a chain of ubiquitin proteins. Previous studies have indicated that ubiquitin chain linkage (the connectivity between each ubiquitin in the chain) affects the unfolding ability of the proteasome, such that substrates ubiquitinated with K63-linked chains by Rsp5 were less completely degraded than those ubiquitinated with mixed K48/K63-linked chains by Keap1. Previous results were obtained with trace radioactively labeled substrates, which are unsuitable because radioactive labeling does not emit an adequate signal to track fragment formation for Keap1 ubiquitinated substrate.The goal of this research was to develop a fluorescently labeled substrate and verify previous results asserting higher unfolding ability with Keap1 ubiquitination than Rsp5 ubiquitination. A Neh2Dual-Barnase-Dihydrofolate Reductase (DHFR) construct was mutated to contain a single cysteine for fluorescent labeling. Protein was expressed, purified and labeled with Cy5. Degradation assays using the modified substrate in the presence of NADPH and Methotrexate, which stabilize DHFR leading to proteasomal release of a DHFR-containing fragment, were conducted. Analysis reveals greater fragment formation for the Rsp5 ubiquitinated substrate than the Keap1 ubiquitinated substrate, and accordingly a lower unfolding ability, validating the use of this fluorescent substrate to measure proteasomal unfolding abilities.

A-10: Development of a novel method to allow high throughput sequencing of pre-mRNA and mRNA in eukaryotes

Author: Luke Izzo
Advisor: Dr. Elaine Youngman

The regulation of gene expression is crucial for proper cell function whether it be growth, maintenance, or proliferation. A useful tool for quantifying changes in gene expression in differing cell lines, growth conditions or mutant strains is the use of next-generation sequencing of a cDNA library prepared from cellular mRNA. Importantly however, observed changes in gene expression could result either from differences in transcription (transcriptional regulation) or in mRNA stability (post-transcriptional regulation). To distinguish between these fundamentally different modes of gene regulation, we have developed a novel method to enrich both mRNA and its precursor (pre-mRNA) from total cellular RNA preparations. Only about five percent of cellular RNA is mRNA, and pre-mRNA is even less abundant. The remaining cellular RNA is ribosomal (rRNA, 90%), and other

structural RNAs that are not of interest. The prevailing method for enriching mRNA while depleting structural RNAs is poly-A selection, which depletes pre-mRNA. Competing methods based on subtractive hybridization of structural RNA species are costly and species-specific. To make sequencing and qPCR analysis of pre-mRNA and mRNA both effective and low cost, this new method takes advantage of the differing chemical structures at the 5' termini of mRNAs and pre-mRNAs (which bear a 7-methylguanylate cap) and noncoding structural RNAs such as rRNA (which bear a monophosphate). In order to selectively degrade structural RNA while leaving both mRNA and pre-mRNA intact, total RNA preparations were treated with a 5'-monophosphate-dependent exonuclease (Terminator, Epicentre Biotechnologies). Two methods were utilized to evaluate 18S rRNA depletion relative to mRNAs: qPCR quantification of 18S rRNA and mRNA for the housekeeping gene act-3, Bioanalyzer microfluidics analysis of the concentration of rRNAs in treated vs untreated preparations. Both analyses show a 20-fold depletion of rRNA levels, and qPCR analysis shows a minimal effect on the housekeeping gene act-3. A simple chromatography system is being tested to further deplete small structural RNAs including transfer RNA (tRNA), and deep sequencing libraries are being prepared to compare the efficacy of this method to standard poly-A enrichment. Efficient depletion of noncoding sequences allows for the use of lower read sequencing runs even for non-abundant transcripts, reducing the cost of sequencing projects by an order of magnitude, and the initial success of this method suggests that it will be useful in gene regulation studies that require mRNA and pre-mRNA sequencing.

A-11: Synthesis and observation of steric hindrance of substituted Bicyclo[3.2.1]octanones
Authors: Nicholas Forelli, Dr. Brian K. Ohta, and Dr. Eduard Casillas
Advisor: Dr. Eduard Casillas

In the synthesis of Deoxyprehelminthosporol, an unusual observation regarding the electrophilicity of a ketone was made. While attempting to alkylate a substituted bicyclo[3.2.1]octanone1 the ketone was left untransformed and the ester underwent a double addition. The purpose of this project is to investigate the reasoning for this occurrence. Two explanations are that the steric hindrance of the molecule blocks the necessary Bürgi-Dunitz angle for ketone alkylation or the α carbon prefers enolate formation. To test this hypothesis, a number of bicyclooctanones are being synthesized, which include or exclude the alkyl or ester functional groups. These compounds are being alkylated with methyl lithium to observe the role each functionality played in blocking the ketone. A total of six analogs have been targeted for alkylation, three of which have been tested thus far. Early alkylation experiments have shown ester double addition as well as stereospecific deuterium labeling and alcohol formation. Based on these early experiments, it is believed that the increased steric hindrance caused by the ester blocks the approach for alkylation, allowing for a more favorable enolate formation.

A-12: Ruthenium anticancer project
Author: Lauren Winkler
Advisor: Dr. Matthew McLaughlin

This summer research was done on the bonding of the anticancer drug Ru(bpy)2(6,6'BOXY) from the Paul Lab with 9-ethylguanine and, later, double stranded DNA with help of the Palenchar Lab. The focus was on bonding and the conditions of bonding evaluated through processes such as UV-Vis and gel electrophoresis. From this it was proven that there is a bonding site available in the Ru(bpy)2(6,6'BOXY) molecule once the BOXY ligand has fallen off. That site is able to bond to species such as phenanthroline and 9-ethylguanine. Next, gels of double stranded DNA mixed with

increasing concentrations of Ru(bpy)2(6,6'BOXY) were run to show contrast between the lengths that the bonded compound ran. The results supported the hypothesis that Ru(bpy)2Cl2 bonded to double stranded DNA because of clear slowing in the migration of DNA across the acrylamide gel. At the end of the summer, further questions were raised. Future experiments to differentiate between intercalating and covalent bonding within the DNA have been proposed using techniques such as crush and soak and crystallization of DNA.

A-13: Different roles of reactive oxygen species in electrophile mediated Nrf2 activation
Author: Chang Jeong
Advisor: Dr. Aimee Eggler

Electrophiles such as sulforaphane, a clinically relevant molecule, and reactive oxygen species (ROS) have been shown to activate Nrf2, a highly studied regulator of antioxidant response elements (AREs), which control expression of antioxidant and detoxification genes. No one in the field, however, has combined electrophiles and ROS to assess Nrf2 and ARE activation. The following investigation not only confirms our previous experiments that ROS in the presence of sulforaphane enhances ARE activation but also provides further evidence on specific effects on expression of the ARE-regulated genes AKR1C1, NQO1, and HO-1. To measure the expression of these genes, western blots were conducted in the presence of sulforaphane and dtBHQ, a ROS-producing molecule. Evidence of differing trends in activation of AKR1C1, NQO1, and HO-1 suggests that activation of each gene by electrophiles and ROS is complex and points to other regulatory factors having an effect. Further tests conducted with MnTMPyP, a superoxide dismutase mimetic, and catalase, which decomposes hydrogen peroxide, suggest roles for specific reactive oxygen species in ARE gene activation, namely superoxide and hydrogen peroxide.

A-14: Substrate ubiquitination controls the unfolding ability of the proteasome
Authors: Eden L. Reichard, Giavanna G. Chirico, William J. Dewey, and Dr. Daniel A. Kraut
Advisor: Dr. Daniel A. Kraut

In eukaryotic cells, proteins are targeted to the proteasome for degradation by polyubiquitination. These proteins bind to ubiquitin receptors, are engaged and unfolded by proteasomal ATPases, and are processively degraded. The factors determining to what extent the proteasome can successfully unfold and degrade a substrate are still poorly understood. We find that the architecture of polyubiquitin chains attached to a substrate affects the proteasome's ability to unfold and degrade the substrate, with K48- or mixed-linkage chains leading to greater processivity than K63-linked chains. Ubiquitin-independent targeting of substrates to the proteasome gave substantially lower processivity of degradation than ubiquitin-dependent targeting. Thus, even though ubiquitin chains are removed early in degradation, during substrate engagement, remarkably they dramatically affect the later unfolding of a protein domain. Our work supports a model in which a polyubiquitin chain associated with a substrate switches the proteasome into an activated state that persists throughout the degradation process.

Biology

A-15: Deregulation of DZIP1L in mammary tumor cells
Author: Gerard Walker
Advisor: Dr. Janice Knepper

Upregulated Fliz1 expression is associated with invasive, metastatic phenotype in epithelial cells. In examining the regulatory effects of Fliz1 upregulation, RNA Seq analysis of Fliz1 transfected and un-transfected cells showed a 26 fold downregulation of DZIP1L in Fliz1 transfected cells compared to controls. The function of DZIP1L is largely uncharacterized yet, DZIP1L has shown to be necessary for proper formation of the primary cilium in human cells, a hub where components of the hedgehog signaling pathway are docked and processed. Without the primary cilium, the hedgehog signaling pathway does not operate correctly, which may often lead to induction of a cellular program called Epithelial-Mesenchymal Transition (EMT) as well as augmented motility and invasiveness into neighboring tissues. Thus, the following proposal hypothesizes that the mechanism for Fliz1 induced tumor cell invasiveness consists of DZIP1L repression, and subsequent inhibition of primary cilium formation, which is vital for proper hedgehog signaling. In order to test whether or not DZIP1L is involved in this invasive mechanism, and follows the suggested pathway, murine and human mammary tumor cells will have expression of DZIP1L knocked down (without changing Fliz1). Then, wound healing, Transwell, and soft-agar assays will be carried out to examine cell aggressiveness in comparison to Fliz1 over-expressers. Further, Immunofluorescence will be performed to visualize if the primary cilium has formed correctly in the DZIP1L knockouts and immuno-detection will be used to check for markers of EMT. Finally, if aggressive cell behavior has been induced and/or primary cilium formation altered, then a "rescue" experiment will be performed by adding DZIP1L protein back to the knockout cells via expression vector to see if restoration of the protein reverses the observed changes.

A-16: Investigating the basis of personality: a novel approach using hybrid chickadees
Authors: Breanna Bennett and Dr. Robert L. Curry
Advisor: Dr. Robert L. Curry

Animal personality is consistent, replicable variation in performing tasks, which can vary from species to species. One component of animal personality is exploratory behavior, which is how individuals explore a novel environment. I investigated exploratory behavior as an element of personality in two species of chickadees, Black-capped (BCCH) and Carolina (CACH), and the hybrids (HYCH) they produce. My site was Hawk Mountain Sanctuary in Kempton, PA, which is conveniently located in part of the 100 km chickadee hybrid zone that stretches from the Midwest to the east. BCCH and CACH are sister species, yet seemed to exhibit distinct exploratory behavior between species in preliminary personality studies I conducted. I hypothesized that, because their hybrids' plumage phenotype is intermediate between BCCH and CACH, it is possible that their behavioral phenotype is also intermediate. I constructed a portable exploratory behavior observation chamber in order to investigate the personality of these chickadees in a controlled environment during their spring breeding season from late April/early May to mid/late June. I tested each adult bird that was captured at Hawk Mountain by holding them for a standard 30 minutes, then hanging the cage over a sliding entrance door to the observation chamber. The birds were allotted no more than five minutes to move into the chamber, observed for ten minutes in the chamber, and allowed no more than five minutes

to move out of the chamber and back into the holding cage after the test completed. Verbal observations were recorded via handheld voice recorder. After the test concluded, each bird was banded, standard measurements taken, blood-sampled, and phenotyped based on plumage. The two observation parameters I examined were latency from holding cage into the box, and latency from the box back into the holding cage post-test, in relation to phenotype of the bird. A Bivariate Fit of latency into the box by latency out of the box revealed no correlation between the two parameters, and a Oneway Anova of the latency into the box, latency out of the box, and average overall latency in relation to phenotype revealed no significant differences among BCCH, HYCH, and CACH. Despite this, results suggested that BCCH behaved slower overall compared to HYCH and CACH. A clearer pattern may emerge as more behaviors observed from the exploratory behavior chamber tests are analyzed.

B-17: The role of nuclear protein SMK-1 in age-dependent oxidative stress response in C.elegans

Author: Nimesha Mehta
Advisor: Dr. Matthew Youngman

Healthspan deals with understanding the quality of life towards the end of life. The effect of aging is linked to oxidative stress from ROS, which destabilizes DNA and impacts an organism's ability to combat stress. Caenorhabaditis elegans are a great model for studying aging because they carry many mammalian homologs. For example, DAF-16, a homolog of the human transcription factor FOXO, plays a direct role in longevity and in signaling stress response. Research has also discovered that a nuclear protein, SMK-1, homolog of SMEK-1 in humans, is essential for DAF-16 mediated activity. Previous research in the Youngman lab indicates that SMK-1 has an essential role in protecting organisms from bacterial infection and is necessary in DAF-16's response to infection because when it is knocked down in worms, it decreases survival rate. SMK-1's activity in immunity against infection suggests that it also has a role in preserving healthspan. Because SMK-1 positively regulated DAF-16 in response to infection and during aging, it was assumed that it would act similarly in the oxidative stress assay. The aim of this project was to therefore determine the role of SMK-1 and DAF-16 in combating oxidative stress. Contrary to the findings of the infection assay, inhibiting smk-1 in worms using RNAi increased resistance to oxidative stress as compared to young wild-type worms. This was remarkable because SMK-1 acted as an activator in response to infection, but as an inhibitor of DAF-16 in response to oxidative stress. Not only that, but SMK-1 knockdown showed increased resistance in adult worms, which is significant considering that most organisms, including humans, only have this ability in their youth. These unique results therefore point to future directions of this project in which the activity of SMK-1 can be studied further in mutant backgrounds of other transcription factors involved in oxidative stress such as HSF-1.

B-18: Investigating the role of chromatin remodeler genes in regulating the age-dependent activity of DAF-16, a conserved FOXO transcription factor in C. Elegans

Authors: Safae Bennani and Dr. Matthew Youngman
Advisor: Dr. Phil Stephens

In evolutionarily diverse species, aging can be described as the gradual decline of biological function due to changes in gene expression. Studies of aging in the nematode C. elegans have established that the Insulin/IGF-1 pathway is a key factor in longevity and overall health. The major determinant of lifespan in worms is evolutionarily conserved transcription factor DAF-16. DAF-16 is normally

inactive in younger worms, except in response to acute stress, but we have found that its transcriptional activity increases in an age-dependent manner. Work from our lab and others suggests a role for chromatin remodeling in modulating the transcriptional output of DAF-16. Transcriptional regulation is profoundly dependent on the packaging of the DNA, whether it is open chromatin (euchromatin) or closed chromatin (heterochromatin). Chromatin remodeling is the process that alters the architecture of nucleosomes to allow or block access to regions of DNA through post-translational modifications of histones and/or ATP-dependent chromatin remodeling complexes. Methylation, phosphorylation, ubiquitination, and acetylation are ways by which histones can be modified by chromatin remodeling proteins such as those of the SWI/SNF and NuRD families. Based on a list of genes that were upregulated from L4 (larval stage 4) to D6 (day 6 after adulthood in C. elegans), I was able to select chromatin remodeling genes to test if they were necessary for increased expression of an in vivo reporter for DAF-16 transcriptional activity at D6. Through RNAi-mediated knockdown of chromatin modifiers in the plys-7::GFP worm strain, I was able to perform a microscopy assay to screen for chromatin remodeling genes that phenocopy daf-16. I tested 41 genes and discovered that 3 of those genes were potentially required for the age-dependent increase in DAF-16 activity. The three genes were mig-32; a RING (Really Interesting New Gene) domain containing gene that is predicted to be required for histone H2A ubiquitination, zfp-1; a PHD/LAP (plant homeodomain/leukemia-associated protein) domain containing gene which is predicted to have a role in gene silencing and chromatin binding, and sumv-1; a gene with similarity to the non-enzymatic subunit of the mammalian KAT8/MOF histone acetyltransferase complex. Mig-32 and sumv-1 both encode for gene activating proteins while zfp-1 likely encodes for gene silencing proteins, suggesting that mig-32 and sumv-1 may work with DAF-16 to increase its activity while zfp-1 likely does not help in activating DAF-16 gene targets. Discovering necessary activators for DAF-16 transcriptional activity paves the way for further research on chromatin remodeling in aging studies and understanding the mechanism behind DAF-16-mediated longevity. This would also have implication for studies on human stress responses and age-related diseases as the genes involved in this IGF-1 pathway and chromatin remodeling have human homologs, including FOXO3a, the mammalian version of DAF-16.

B-19: The toxicological effects of hydraulic fracturing fluid the developing zebrafish embryo
Author: Maura Lavelle
Advisor: Dr. Angela DiBenedetto

Hydraulic fracturing, commonly referred to as fracking, is a method of extracting natural gas out of shale deposits from deep underground to use as energy. This process requires the use of a fluid to be injected into the earth at high pressures to crack shale deposits in order to release gas. The goal of this research project is to evaluate the toxicological effects of hydraulic fracturing fluid on developing zebrafish embryos. A toxicological assay was used in order to determine the effects of fracking fluid on zebrafish embryos. There were many benefits to using zebrafish as a model system for this experiment; however the biggest advantage of using zebrafish is that embryonic development occurs outside of the mother which allows the embryos to be completely visible to study. After determining that the high salinity of the fracking fluid was not a significant factor in the observed mortality and abnormality of the embryos, several range finding tests were carried out using various dilutions of fracking fluid in order to narrow in on LC50 and EC50 values. LC50 values are regression estimates of the concentration at which 50% mortality occurs and EC50 values are regression estimates of the concentration at which 50% of the embryos showed an effect (mortality or malformation). The procedure used for these range finding tests modeled that of A. Hagenaars et al. (2011). Embryos were

exposed at 5 hours post fertilization (hpf) to five treatments and a control of 1 x E3 medium. Embryos were examined every 24 hours, beginning at 24 hpf and continuing until 120 hpf. Mortality, hatching rate, and presence of abnormalities were the endpoints recorded for the range finding tests. Throughout this project lethal, sub lethal, and teratogenic effects were recorded and photographed. These preliminary experiments demonstrated that fracking fluid may negatively impact the development of zebrafish. Statistical analysis of results will provide LC50 and EC50 values. With these values, a full early life stage test containing additional endpoints will be completed.

B-20: Role of cellular interactions between CD4 + T-cells and antigen presenting cells in regulation of lipid raft-based membrane order, survival and antigen-specific proliferation of CD4+ T cells

Authors: Haun Hwang and Dr. Anil Bamezai
Advisor: Dr. Anil Bamezai

My overarching research goal for the summer was to develop a deeper understanding of the fundamental principles and mechanisms underlying CD4+ T cell survival and responses, more specifically to examine the role of lipid rafts in these cellular processes. CD4+ T cells play a critical role in immunity, and lipid rafts are nanometer domains on the plasma membrane composed of saturated lipids, cholesterol and many signaling proteins that play an important role in cellular signaling. T cell responses, in vivo, are first initiated in the lymphoid tissues, such as lymph nodes, where cellular interactions between immune cells is maximized. Prior to initiation of immune response, foreign antigens are captured at the barrier surfaces (skin and mucosa) by antigen presenting cells (APC) and brought to the nearest lymph node via lymphatics to be presented to naive T cells. Immunological synapse formed at the contact site of antigen presenting cell and T lymphocyte shows a high organization of interacting molecules, such as Major Histocompatibility Complex II on the APC and TCRαβ receptor and CD3 signaling proteins on the T cell side. In addition, trans-membrane molecules such as CD28, LFA1 and CD4 expressed on CD4+ T cells, participate in cell-cell interaction and allow the kinases in the cells to start a signaling cascade leading to clonal expansion of CD4+ T cells which is vital to effective elimination of the pathogen. Understanding the dynamics of membrane lipid microenvironment (lipid rafts) where the TCRαβ receptors reside is fundamental to the understanding of the trigger for the cell signaling pathways.

I hypothesized that CD4+ T cells that are more congregated (as in lymph node) would have increased membrane order, survival and proliferative response to a specific antigen than the cells that are not closely congregated. To address my hypothesis, I cultured cells in round bottom and flat bottom culture wells. Culturing APCs and T cells in round bottom wells forced close interactions between cells to occur, while mimicking the lymph node and the conditions in the body as accurately as possible. Control cultures were set up in flat bottom wells where cells are further away from each other. I measured the cell-density dependent changes in lipid-raft based membrane order, survival and antigen-driven proliferation in CD4+ T cells. These data will be discussed.

B-21: Pdc2 and Thi3 in Candida glabrata regulate both amino acid and thiamine starvation and mediate the switch of biosynthetic capacity in response to starvation

Authors: Christine L. Iosue, John Nahas, Danielle Sens-Castet, Emma Lang, and Dr. Dennis Wykoff
Advisor: Dr. Dennis Wykoff

Transcription factor specificity is different for some signal transduction pathways in Saccharomyces cerevisiae and Candida glabrata. For the thiamine signal transduction (THI) pathway there are a number of differences between the two species at the level of signaling and transcription.

By comparing the THI pathways in the two species, we have uncovered a novel molecular switch that alters the expression of thiamine and amino acid biosynthesis genes. In S. cerevisiae, PDC2 encodes a transcription factor that activates the transcription of both thiamine biosynthetic genes and glycolytic genes. Proper regulation of thiamine responsive genes requires the additional regulators Thi2 and Thi3. C. glabrata is missing THI2; however, C. glabrata is still capable of inducing THI genes, indicating a difference in transcriptional requirements.

Deletion of ScPDC2 appears lethal in S. cerevisiae because cells are unable to utilize glucose effectively. In C. glabrata, there is no apparent growth defect in a Cgpdc2Δ strain, suggesting that Pdc2 regulates different genes between the two species. RNA-seq experiments with wildtype, Cgpdc2Δ, and Cgthi3Δ strains indicate that CgPdc2 regulates both thiamine and amino acid biosynthesis genes and not pyruvate decarboxylase genes. Interestingly, in wild-type C. glabrata, amino acid biosynthesis genes are upregulated in thiamine-replete conditions and ~10-fold repressed during thiamine starvation. This repression is lost in a Cgthi3Δ, suggesting CgThi3 plays a role in recruiting CgPdc2 to THI promoters in thiamine-limited conditions. We are exploring the altered regulation of genes by CgPdc2 by identifying the cis element(s) that CgPdc2 binds using promoter-YFP fusions with flow cytometry as well as in vitro EMSA experiments. We are also performing crosscomplementation studies to determine whether CgPdc2 is capable of rescuing the lethality of the Scpdc2Δ strain. This work should uncover a novel mechanism by which C. glabrata cells partition energy to either synthesize amino acids or synthesize thiamine, using the occupancy of promoters by CgPdc2 as the switch.

B-22: Investigating the number of generations required to trigger transgenerational inheritance of learned pathogen avoidance of pathogen exposure in the nematode Caenorhabditis elegans

Author: Laura Meissner
Advisor: Dr. Elaine Youngman

A necessary skill for survival is the ability to remember and learn from experience, and this capability is even present in the simple model nematode Caenorhabditis elegans (C. elegans). For example, after infection by one of several pathogenic strains of bacteria, C. elegans learn to avoid the pathogen and are instead attracted to non-pathogenic food sources through a mechanism involving alterations in serotonin expression in specific chemosensory neurons. This behavior is considered a classic example of associative learning— that is, C. elegans associate their infection with the odor of the pathogenic bacterium, and learn to avoid it. Given the recent discovery of the role neurons play in directing siRNA to the germline to produce epigenetic changes, we hypothesized that the observed behavioral modifications C. elegans exhibit in its pathogen avoidance after exposure to pathogenic bacteria would be heritable and involve a siRNA pathway. I previously demonstrated in preliminary experiments that the learned avoidance of the pathogenic Pseudomonas aeruginosa strain, PA14, in C. elegans is heritable for several generations after infection by the pathogen has been removed. This is in defiance

of the laws of traditional mendelian inheritance, as it is the experience of the parental generations that lead to alterations in progeny phenotypes. Interestingly, worms must experience infection by PA14 for several generations before the learned avoidance behavior is heritable. This summer, the number of generations required to observe heritable learning was investigated. The future step is to determine the mechanism underlying this heritable learning through the use of strains of C. elegans containing mutations in different genes within endo siRNA pathways.

B-23: Soil phosphorus in lowland tropical rainforests - a constraint for deep soil microbial activity?

Authors: Megan Foley and Andrew Nottingham
Advisor: Dr. Adam Langley

The disproportionately large role of tropical forests in the global carbon cycle and the uncertainty surrounding soil-climate feedbacks in response to climate change render the fate of tropical soil carbon to be of particular importance. Despite the importance these soils in the global carbon cycle, the fate of tropical soil carbon stocks under elevated temperature remains unclear; however long term warming experiments suggest that the microbial response to elevated temperature may be constrained by several factors, including nutrient limitations (Melillo et al. 2010). I performed a laboratory-based incubation experiment to test the effects of Nitrogen (N) and Phosphorus (P) availability on decomposition in shallow (0-10cm) and deep (50-100cm) soils collected from both a lowland tropical forest and a montane tropical forest in Panama. Nutrients were added with carbon (C) to 30g of soil, and soils received either carbon alone (C), nitrogen (CN), phosphorus (CP) or nitrogen and phosphorus together (CNP). CO2 production was measured by NaOH capture and titrimetric analysis for the following 10 days. The cumulative amount of carbon respired was shown to increase in deep soils collected from the lowland site with additions of CP and CNP ($p=3.52e-07$), suggesting microbial processes in deep lowland tropical soils are phosphorus-limited. These results support the current understanding of nutrient limitations in lowland tropical forests, and provide evidence that deep soil organic matter in tropical soils may be particularly stable due to a lack of biologically-available phosphorus. Further, this study suggests that soil C losses in lowland tropical forests may be constrained under elevated temperature.

B-24: The future of plant-fungal symbioses along elevational gradients

Author: Andrew Freed
Advisor: Dr. Samantha Chapman

Plant-fungal symbioses affect the growth and fitness of most plants on earth. Moreover, they can structure plant community composition and feedback to affect ecosystem-level properties such as carbon storage. As climate change drives species distribution shifts in plants, the fungi may or may not co-disperse along with their symbiotic plant species. Thus, the future of these relationships could look very different, and owing to the potential community and ecosystem-level ramifications, it is important to understand the consequences of these potential plant-symbiont mismatches. We simulated the species distribution shift of Festuca thurberi and Festuca saximontana expected under climate warming in the next century and manipulated the fungal communities of plants at high and low elevation. We found that broadly distributed Festuca saximontana will perform poorly if associated with fungi from low elevation, regardless of which elevation it is grown in. Festuca thurberi on the other hand, will perform better at all elevations if they co-disperse with their fungi from lower

elevations. This difference in performance could disrupt current montane plant communities and lead to a change in carbon storage and nutrient cycling in these ecosystems.

B-25: Evaluating the potential of vitamins C and E to enhance induction of cytoprotective proteins by sulforaphane

Author: Anish Vora
Advisor: Dr. Aimee Eggler

Nrf2 is a transcription factor that mediates responses against oxidative and electrophilic stresses in the body. It does so by binding to portions of genomic DNA known as antioxidant response elements (AREs), found upstream of genes that code for cytoprotective proteins. This binding leads to the upregulated expression of these proteins, believed to preclude or lessen numerous chronic diseases. Importantly, a number of small molecules, many from the diet, can activate Nrf2 and show promise in clinical trials for disease prevention. One major mechanism of Nrf2 activation is relieving the repression of the Keap1 protein, a repressor that facilitates the polyubiquitination of Nrf2, thus leading to its proteasomal degradation. Towards this, electrophiles such as sulforaphane (SFN) from broccoli sprouts, studied in over 20 clinical trials, interfere with the repression and allow for accumulation of Nrf2.

The phenomenon of redox-cycling is crucial to Nrf2 and ARE activation by small molecules known as oxidizable phenols. Oxidizable phenols, while not electrophiles in their reduced forms, can easily be oxidized (lose electrons), turning them into electrophiles capable of reacting with Keap1 cysteines. The electrons lost form reactive oxygen species (ROS) after being delivered to oxygen. The electrophile form created in the process can be reduced in the cell and the cycle can continue, hence the term "redox-cycling", creating more and more ROS. Our preliminary data in HaCaT cells with the redox cycling agent 2,5-di-tert-butylhydroquinone (dtBHQ) , whose oxidized form cannot act as an electrophile, show ROS on their own do not seem to substantially activate the ARE. However, significant activation of an ARE reporter construct as well as ARE-regulated genes like AKR1C1 and HO-1 are seen when dtBHQ is coupled with SFN.

The goal of my project was to see if activation of ARE-regulated proteins by SFN is enhanced by the non-electrophilic redox-cycling of vitamin C or vitamin E, similar to our observed results with dtBHQ. These vitamins, unlike dtBHQ, are approved for clinical use. Based on Western blot tests of vitamin C titrations coupled with SFN for AKR1C1, and of vitamin E titrations coupled with SFN for HO-1, AKR1C1, and NQO1, though, our data suggest that the vitamins do not efficiently replace dtBHQ as redox-cyclers. In both cases, there was no conclusive evidence to show that the addition of one of the antioxidants increased accumulation compared to that of SFN alone. Importantly, a side-by-side comparison of dtBHQ and the vitamins is needed to compare the extent of effects. We plan to test addition of copper to catalyze redox cycling, as the vitamins may require higher concentrations of transition metals than those present in the cells for the process. Other future testing may include using other versions of the vitamins such as Trolox, a water soluble analog of vitamin E.

B-26: Pathway and evolutionary analysis of Glycosyltransferase enzymes to explore conservation and classification of families

Authors: Jakub Glowala, Rahil Taujale, and Natarajan Kannan
Advisor: Dr. Dennis Wykoff

Glycosyltransferases (GTs) catalyze the transfer of an immense diversity of sugar moieties to acceptor molecules yet paradoxically contain very little sequence homology even within catalytic domains [1].

Aside from classifying them broadly into one of three major fold structures (A, B, C or not classified), sequence analysis has proved inadequate in consistently predicting inversion or retention mechanisms or molecular function [2]. These enzymes play a role in diverse pathways including signaling, cell recognition, and detoxification reactions and therefore further analysis may have important applications across a variety of domains [3]. In this study, we set out to combine information from pathway databases and Bayesian partitioning software to further refine the classification curated by the CAZy (Carbohydrate Active Enzyme) database and to explore the evolutionary relationship between these enzymes. The results of the study show promising enrichment for the GT7 and GT31 families in pathways across organisms and the identification of patterns of residues by the omcBPPS software which appear to have structural significance for these two families. Further analysis and search parameters must be explored to empirically determine the biological significance of these patterns and other relationships between the GT enzymes.

B-27: Effect of chronic and acute exercise on the electron transport chain in mouse liver

Authors: Katherine A. Monroe and Dr. John M. Olson
Advisor: Dr. John M. Olson

Sustained exercise is supported by high aerobic fluxes, dependent upon the electron transport chain (ETC), a series of protein complexes in the inner mitochondrial membrane. When the ETC is overwhelmed or inefficient, electrons stall and may leak from the chain and form free radicals. Free radicals are highly reactive molecules with an unpaired electron that cause damage to lipids, proteins and DNA, and the resulting oxidative stress has been linked to numerous diseases. Thus, there is a strong selective advantage to protect against oxidative stress, especially after prolonged exercise. Consistent with this, both the gastrocnemius and liver of mice trained for aerobic exercise have lower oxidative stress following an acute exercise bout relative to their untrained counterparts (Kearney, Rivera, and Olson, unpubl.) The improvement in protection against oxidative stress is apparently not due to upregulation of the key enzymes SOD2 and GPx4 (Trimboli and Olson, unpubl.), leaving the reason for the improvements unclear. This study tests the hypothesis that reduced oxidative stress levels in the liver after training are due to improved efficiency of the ETC resulting from increased activities of the four primary complexes in trained mice. In addition, it is possible that acute exercise will also induce upregulation of the complex proteins, even in untrained animals. To test these hypotheses, ETC complex 2 (succinate dehydrogenase) activity levels were measured in mouse liver samples following the methods of Spinazzi et al. 2012. Thirty mice were housed in groups of 4 and subdivided in to two main age-matched groups- one that swam for an hour a day, 5d/week for two weeks ("Trained"), and the other that was sedentary ("Untrained"). To test baseline levels as well as the effects of acute exercise on the day of sampling, one was sampled before a swim, and the other three were swum for 1 h, and sampled immediately, 5h, or 24h after the swim. This allowed the assessment of the effect of training and whether the response is immediate. Mice were euthanized via CO2, their livers dissected, weighed, minced, and frozen before prep for the assays. All results were evaluated by 2-way ANOVA, with experimental group (training/control) and sampling time (pre-swim, 5 hour, and 24 hour) as the two factors. Neither body mass nor liver mass were significantly affected by training, although there was a tendency for some changes following the acute swim. Baseline complex 2 activity levels also did not differ significantly between training groups; however, activity increased significantly in trained mice within 5h after exercise with no change observed in untrained mice after acute exercise. These data suggest that training improves the capacity for flux through the ETC.

Business

B-28: What is the effect of variations in gender composition of school boards on school budgets?

Author: Rachel Azzoli
Advisor: Dr. Sutirtha Bagchi

I chose to research the question "What is the effect of variations in gender composition of school boards on school budgets?" To answer this question, I collected data on school board elections and school district budgets. Then, I hoped to asses a variation of school board compositions based on the percentage of seats held by men and women respectively. I sought to focus on scenarios in which a) school board elections indicate that there is a woman on the board when there was previously none and b) school board elections indicate that a board has moved from a slender majority of men to a slender majority of women. In order to estimate the true causal impact of the latter scenario, I planned to utilize a regression-discontinuity design in which I would compare school boards that are comprised of a slim majority of women versus school boards comprised of a slim majority of men. Next, I hoped to compare the school board budgets of districts that fall under the aforementioned scenarios to the average of other school board budgets. By making such comparisons, I hoped to uncover results linking the gender composition of school boards to school board budgets. During this process, I learned that data collection is an extremely time consuming process. I spent most of my summer on the initial steps of my plan to investigate my research question and as a result have not yet produced a conclusive answer to my research question.

I hope to eventually learn the answer to my research question. Education is the single biggest category of spending by local governments, accounting for about one-third of total spending. Yet, there is no literature that studies the factors that affect spending by local school districts. There is an existing literature in Finance that discusses the relationship between the number of women and/or the number of minority board members and financial performance of companies (e.g. Carter, D'Souza, Simkins, & Simpson). Additionally, there is literature that researches the potential effect that mayoral partisanship has on local government budgets (Ferreria & Gyourko; Gerber & Hopkins). This existing literature investigates similar trends to what I wish to research, however there seems to be no literature that investigates the potential relationship between the gender composition of school boards and school board budgets. Since local governments devote much of their budget to education, it is significant to uncover the different factors that have the ability to affect school budgets.

Data on local elections proved difficult to uncover as it is not as readily available as data on state or national elections. Through my experience with the Villanova Freshmen Match Research Program, I managed to uncover a few good data sources such as ballotopedia.org, leap-elections.org, as well as local sites with local school board election information. Much of my time researching I spent compiling this election data as well as school board budget data into Microsoft Excel documents where they could be more conveniently accessed and analyzed.

Chemistry

B-29: Synthesis and purification of [(bpy)2Ru(bpm)Ru(bpy)2][PF6]4 (bpy = 2,2'-bipyridine, bpm = 2,2'- bipyrimidine)

Authors: Claire Teahan and Dr. Jared Paul
Advisor: Dr. Jared Paul

There is a growing need for renewable fuel sources as fossil fuels are being depleted, have become difficult to find, are controversial to extract, and come with a great deal of cost uncertainty. The sun's abundance of solar radiation makes it a very attractive renewable energy source. However, the challenge involves the complex process of water oxidation to convert solar energy into storable energy forms for times when the sun is not shining. Numerous studies within The Paul Laboratory have been carried out with hydroxyl-substituted polypyridyl ligands, such as 4,4'-bpy(OH)2 (4,4'-bpy(OH)2 = 4,4'-dihydroxy-2,2'-bipyridine), in search of an effective catalyst for water oxidation, however all of these complexes have been monometallic. My research focused on bimetallic complexes – a new and exciting direction for the laboratory. The purpose of my summer research was to synthesize and study [(bpy)2Ru(bpm)Ru(bpy)2]4+ (bpy = 2,2'-bipyridine, bpm = 2,2'-bipyrimidine). Purification of this compound was attempted using a Sephadex LH20 column. This dimer was analyzed using many different characterization tests including ultraviolet/visible absorbance spectroscopy, infrared spectroscopy, and several other techniques. I was able to synthesize, purify and then analyze this complex using a myriad of characterization studies. The future direction of this research is to synthesize other bimetallic complexes and through extensive testing find the most appropriate metal-ligand combination to act as an optimum catalyst for water oxidation.

B-30: Printing of NiO/YSZ anode on to YSZ electrolyte via Aerosol Jet Three-dimensional Printer

Authors: Andrew Yun and Dr. Bryan Eigenbrodt
Advisor: Dr. Bryan Eigenbrodt

Solid oxide fuel cells are a great alternative source of energy. The method of applying electrodes onto solid oxide fuel cells involve a method of tape casting, electrode paste is applied by using a flat blade for application, and scraping of excess paste. This method is very crude in that the thickness and microstructure of the electrode cannot be manipulated freely. This experiment delves into the microcosm the anode of a Ni/YSZ fuel cell. A new method known as Aerosol Jet three-dimensional printing, was used to print anodes, specifically Nickel oxide and yttrium stabilized zirconium ink, onto YSZ electrolytes. New anode ink was formulated to allow for most consistent deposition rates and minimal clogging. Physical print head characteristics such as stage speed, print head height, spacing between each streak of ink were all varied to create ideal, non-overlapping streaks. After, the number of layers of anode was varied in order to control the thickness of the anode. Cells of different anode parameters were tested via linear sweep voltammetry, electrochemical impedance spectroscopy, and scanning electron microscopy, ultimately to determine ideal anode printing parameters and produce fuel cells yielding greatest voltage and highest efficiency. Upon determining the ideal anode printing parameters, different concentrations of cornstarch were added to ink formulations to further control porosity of anodes, and were tested in the manner stated above.

B-31: Cyclopropyl glycoside donor for the synthesis of lipid A disccarharide
Authors: Hannah Curran and Jeffrey Hupf
Advisor: Dr. Robert Giuliano

Lipid A is the innermost of the three regions of the lipopolysaccharide molecule that is responsible for the toxicity of gram-negative bacteria. It is also responsible for adjuvant activity toward protein and carbohydrate antigens. Although its toxic effects can be harmful, it is also believed to be a major component of stimulating the immune system in response to Gram-negative infections; it presents itself as an area of interest for potential use in antibiotics. The core structure of lipid A consists of two β-linked glucosamines with attached acyl chains. Our approach to the synthesis of the lipid A disaccharide is based on the coupling of a cyclopropyl glycoside donor and a diol acceptor. Past obstacles of our pathway included the failure of the glycosides to couple due to the inability of the glycoside acceptor to withstand the reaction conditions. If the coupling is successful, it will contribute to existing methodologies for the synthesis of lipid A.

B-32: Detection of lipid accumulation in algae resulting from nitrogen deprivation
Authors: Janelle Gerardi, Tamanna Sultana, and Dr. Bryan Eigenbrodt
Advisor: Dr. Bryan Eigenbrodt

Our world today relies almost completely on fossil fuels, a resource which is depleting in supply, contributing to global political conflicts, and negatively affecting our environment. For these reasons, a renewable, environmentally friendly fuel source must be found. Of the various renewable fuel sources that have been considered, biofuels generated from algal systems seems to be the most promising to be integrated into our current energy infrastructure. The research presented, will explore the effects that nitrogen deprivation, in the form of nitrates, will have on the growth rate and lipid accumulation in the algae specie, Nannochloris eucaryotum. Analytical techniques including fluorescence spectroscopy and transmission electron microscopy were used to quantitatively and qualitatively explore the extent of these effects on the lipid storage mechanism inside these cells. The fluorescent stain Nile Red was used to understand the nature of stored algal lipids by investigating how standards of polar (phosphoacylglycerides) and neutral (mono-, di-, and triacyclglycerides) lipids can cause a shift in the lipid fluorescent peak. A significant increase in triacylglyceride lipid production was observed as nitrogen concentration was decreased in the growing medium. To visualize this effect, TEM was used and a significant increase in lipid body formation can be viewed in the cells that were grown in a nitrogen deprived environment. Understanding the fundamental chemistry behind increasing lipid storage in these algal systems will aid in the utilization of this renewable resource for future generations.

C-33: Synthesis and characterization of ruthenium anticancer prodrugs
Author: Ashley Arcidiacono
Advisor: Dr. Jared Paul

There is interest in studying the fundamental properties of Ru-polypyridyl complexes due to their vast potential as anticancer agents and rich photochemistry. Current trends in the inorganic field of anticancer research have focused on strong electron-withdrawing complexes as powerful anticancer agents. The ligand 5,6-phenanthroline-1,10-dione (phen=O) has a unique electron withdrawing quinone structure, which makes it a particularly interesting ligand to study as a possible potent anticancer agent. When coordinated to large transition metals, phen=O can disturb a wide range of

biological systems. In addition, phen=O coordinates to metals to make non-mutagenic complexes, unlike the most widely used metal anticancer agent, cisplatin. To this end the ligand was synthesized and studied when coordinated to a ruthenium metal center with additional polypyridal ligands. The synthesis and study of phen=O, Ru(phen=O)2Cl2 , and [Ru(phen=O)2bpy][PF6]2, (bpy = 2,2'-bipyridine; (phen=O) =5,6-phenanthroline-1,10-dione) are reported. Verification of synthesis and electronic properties of the resulting complexes were studied using cyclic voltammetry, UV/visible spectroscopy, infrared spectroscopy, and Nuclear Magnetic Resonance (1H NMR).

C-34: Ligand development for iron catalyzed atom transfer radical polymerization
Authors: Vaidehi Shastri and Dr. Deanna L. Zubris
Advisor: Dr. Deanna L. Zubris

Inorganic chemistry plays an important mechanistic role in Atom Transfer Radical Polymerization (ATRP), where a metal-based catalyst helps to mediate a controlled (""living"") free-radical polymerization yielding polymers with precisely controlled polymer molecular weights. Copper- based ATRP catalysts dominate the ATRP field. These copper catalysts are typically prepared in situ and structural elucidation for the metal-ligand complexes is generally not emphasized. Iron -based ATRP catalysts have potential advantages over copper-based systems due to iron's high natural abundance, low cost, and biocompatibility. Our group is working to refine guiding principles for successful iron-based ATRP, in particular with respect to ligand design. Herein we describe recent efforts to prepare (imino)pyridine iron(II)bromide complexes.

C-35: Development of Iron(II) catalysts for atom transfer radical polymerization
Authors: Sarah E. Jenny, Marianne R. Donley, Dr. Laura M. Thierer, Lindsey M. Round, Dr. Nicholas A. Piro, Dr. Wm. Scott Kassel, and Dr. Deanna Zubris
Advisor: Dr. Deanna Zubris

Polymers can be made more sustainably through the Atom Transfer Radical Polymerization (ATRP) mechanism. Over the past two years, the Zubris Group has developed six iron catalysts to encourage ATRP in styrene polymerizations with the goal of using these catalysts to perform polymerization reactions to make specialty polymers. Work done this past year by the Zubris Group has focused on characterization and polymerization testing on the six previously synthesized structures, as well as the development of a new class of iron ATRP catalysts incorporating an N-heterocyclic carbene (NHC). A silver complex with an NHC ligand scaffold was successfully synthesized and characterized, and attempts to transfer the ligand scaffold to an iron atom in order to form a catalyst are ongoing. This catalyst will then be characterized and tested for ATRP activity in comparison to that of the earlier Zubris catalysts.

C-36: Investigating the photochemical fate of triclosan as a function of water quality
Authors: Matthew Petrie, Garrett Waligroski, and Dr. Amanda M. Grannas
Advisor: Dr. Amanda M. Grannas

The increasing environmental risks posed by the presence of pharmaceutical and personal care products (PPCPs) in environmental waters is of great concern. Certain PPCPs intended for human use are being introduced into aquatic ecosystems from human disposal and wastes. It has been found that sewage treatment plants (STPs) do not remove all PPCP chemicals and, therefore, PPCPs are often found in environmental surface waters. Triclosan (5-chloro-2 (2,4,-dichlorophenoxy)phenol, or

TCS) is a common antimicrobial agent that has been found in relatively high concentrations in aquatic ecosystems. The photo-degradation of TCS has previously been shown to produce dioxin-like products, and the photochemical fate of TCS may be altered by various interactions within an aquatic system. The work presented here aims to determine the effect of common water quality parameters on TCS degradation, specifically the impact of ionic strength, pH, and DOM presence. Our preliminary results indicate that increasing ionic strength leads to a longer photochemical lifetime of TCS in aqueous samples.

Computing Science

C-37: Packing congruent spheres into a fixed ellipsoid
Author: Kathleen Ho Sang
Advisor: Dr. Robert Beck

The mathematical question of packing congruent spheres into discrete objects has been well researched due to its many applications. Packing spheres into ellipsoids, however, remains a relatively open field. This specific problem is of particular interest to biologists studying the viability of eggs in eggs sacs. The congruent spheres represent the eggs, and the ellipsoid represents the egg sac. Each sphere may touch one another, but may not overlap. The relationship between the number of spheres in an ellipsoid and their maximum radii is an intriguing mathematical problem and holds importance to other academic fields such a radiology and biology. Sphere packing and circle packing are both well researched, mostly solved problems. Algorithms for circle packing may be used as a gateway for the creation of sphere packing algorithms, and packing algorithms of higher dimensions. Most previous research packs congruent spheres of a fixed size as tightly as possible, into a discrete shape of an unknown size. This research aims to do the opposite; the radius of each sphere is an unknown value, while the discrete object (ellipsoid) is fixed. This research introduces the implementation of ellipsoid.py, a python program that approximates the maximum radii of n congruent spheres packed into an ellipsoid of a fixed size, as well as models of sphere packing in a sphere, and more primitive 2D models.

Economics

C-38: Progressive Strategy
Authors: James O'Donnell and Eric Harris Bernstein
Advisor: Eric Harris Bernstein

Working with leaders in the nonprofit sector and academics, I assisted Roosevelt Institute's Senior Program Associate Eric Harris Bernstein on a quantitative and qualitative analysis of the organizational, financial, and strategic statuses of progressive and conservative nonprofits, respectively. Progressive activist Rob Stein had done similar work over a decade ago, so our project sought to update Stein's work for the 2016 political climate. While many arguments about the ideological battle between the right and the left focus on elections and campaign finance, our work contributes to the important battleground that dictates political discourse in between elections. Based on our data from tax forms, website analysis, and scholarly articles, we found that conservatives have dominated the policy war because of a larger focus on state networks, more robust leadership development program, and a more cohesive message. Our research proposed some priority and

structural changes for progressive nonprofits in order for them to be more effective in the policy-making process.

Engineering

C-39: Producing renewable methane via sorption enhanced catalysis of CO2 methanation
Authors: Kimberly Cardenas and Meridith Chung
Advisor: Dr. Charles Coe

The purpose of this project was to establish a fixed bed reactor system and associated analytics and to evaluate sorbent/catalyst composites for the conversion of CO2 to CH4. The burning of methane as a fuel releases large amounts of carbon dioxide into the atmosphere, contributing to global warming. The reverse reaction of CO2 to CH4, better known as the Sabatier reaction, faces significant thermodynamic limitations since these reductions are normally only carried out at temperatures exceeding 400°C. A sorbent/catalyst composite would allow for increasing the CH4 yield by eliminating the reaction's H2O byproduct. Work on both the reactor system shakedown and preparation of steam stable catalysts were carried out during the summer. Unexpectedly, the initial Ni/Al2O3 catalyst used had to be reduced at 600°C prior to showing activity for the Sabatier reaction. Once properly reduced, a sustained yield of 40% methane was obtained at 400°C. The inclusion of the novel Ni CHA sorbent/catalyst is the next step in proving the sorption-enhanced catalysis approach and is amendable for the Sabatier reaction. The NiCHA was prepared by a topotactic conversion of NaY zeolite pellets and then converted in to the Ni form by ion exchange. Future studies are being carried out as a senior research project within the Chemical Engineering Department.

C-40: Exploring the potential of biochars by-product from biofuels production process as feedstock for the synthesis of advanced carbon material
Authors: Keith Thadikaran, Gregory Zakem, Brandon Shea, and Dr. Justinus Satrio
Advisor: Dr. Justinus Satrio

The use of biomass as an alternative feedstock for the production of carbon-based materials is of growing interest because of its potential ability to reduce the country's dependence on foreign oil and improve the environment by reducing emissions. The biomass feedstock elected for this project is spent mushroom substrate (SMS), which is a waste material produced from mushroom production farms and is readily available in large quantities locally, specifically in Kennett Square, PA, which is known as the 'mushroom capital of the world". In the experimental studies, this feedstock was pyrolyzed to produce a liquid product (bio-oil), solid product (bio-char), and a mixture of non-condensable gases, mainly CO and CO2. Pyrolysis involves thermal decomposition reactions that occur when an organic compound is heated to high temperatures without the presence of oxygen, eliminating the possibility of combustion. The phase of this project is concerned with biochar because of its potential to be used as intermediate feedstock to produce active carbon (super absorbent carbon that can be used as a thermal conductor). In the experiments, biochar materials were steam activated and then analyzed to determine whether the activated char can successfully be added to heat sink materials, such as paraffin wax, to improve thermal conductivity of the materials. In this project, effects of hydrolysis pretreatment on the biomass feedstock using phosphoric acid prior to pyrolysis will be evaluated to determine whether the pretreatment process helps creating a more viable and better quality biochar and active carbon, as opposed to the untreated feedstock. The samples were characterized by using with a Scanning Electron Microscope (SEM) and BET surface area and

microporosity analyzer. The results would be analyzed to determine whether or not there is a benefit to pretreating biomass feedstock in the products. The yields of biochar and active carbon with respect to the original biomass feedstock are to be analyzed too.

C-41: High temperature CO2 sorption by mesoporous lithium orthosilicate
Authors: Akash Dagur and Shane Gillespie
Advisors: Dr. Charles Coe and Dr. Michael Smith

Lithium orthosilicate is a known effective high temperature carbon dioxide sorptive material that functions in the presence of water vapor. However, when bulk lithium orthosilicate—a low surface area absorbent—comes into contact with CO2 gas, a shell of lithium carbonate and lithium metasilicate is formed, preventing CO2 from reacting with and being absorbed by the remaining core of the lithium orthosilicate particle. A sol-gel method was used to make unmodified lithium orthosilicate. A microbalance as well as a thermogravimetric analyzer measured the CO2 absorption and N2 desorption of the compound, thereby indicating the weight percentage of reversible CO2 absorption and the pressure dependence and kinetics of the CO2 uptake. For lithium orthosilicate made from a colloidal silica source, the uptake at 1 atm and 550 ºC was approximately 24 wt%. However, it took about 2 hours to achieve this loading. Efforts to make the compound in question mesoporous by using SBA-15, a mesoporous source of silica, are in progress. A mesoporous lithium orthosilicate particle—since it has a 100-fold increase in surface area—should result in greater and more rapid CO2 absorption. Using this new sorbent in methane reformation reactions should result in more hydrogen gas produced while capturing far more CO2, effectively creating a "green" source of hydrogen fuel.

C-42: Inhibition of the innate immune response to non-viral gene therapy
Authors: Christine Muzzelo, Christopher Neely, Adam A. Butchy, and Dr. Jacob J. Elmer
Advisor: Dr. Jacob J. Elmer

Non-viral gene therapy vectors release DNA into the cytoplasm and can activate a number of host defenses including the innate immune response. This inflammatory response can silence any plasmid DNA that is successfully delivered to the nucleus. For example, toll-like receptor 9 (TLR9) binds foreign DNA through unmethylated CpG motifs and triggers the activation of various transcription factors including nuclear factor κB (NF-κB) and activator protein-1 (AP-1), which then induce a variety of innate immunity related enzymes that silence transgene expression. Our goal is to target this innate immune response to prevent transgene silencing. The effect of several inhibitors of the innate immune response were investigated, including E6446 (TLR9 inhibitor), VX-702 (p38 MAP kinase inhibitor), curcumin (anti-inflammatory drug that suppresses NF-κB activation) and iCRT-14 (β-catenin inhibitor). The efficacy of these inhibitors were determined by quantifying transgene expression (luciferase assay), and cellular proliferation (MTT assay). To verify these inhibitors targeted the innate immune response, we investigated the production of the cytokine IL-6 (ELISA assay), a known downstream signaling molecule of the innate immune cascade. These results show that gene therapy can be significantly improved by inhibiting the innate immune response. In a similar investigation, 13 repeats of the oligodeoxynucleotide (ODN) 2088 were inserted into the pGL 4.50 plasmid. This sequence is known to inhibit the activity of TLR9, and the insertion of these repeats increased transgene expression when compared to the traditional plasmid.

C-43: Building a low cost chromatography system
Author: Brianna Conte
Advisor: Dr. Jacob Elmer

Commercial chromatography systems can be extremely costly, for example the GE AKTA Pure system costs approximately $44,000. The goal of this project was to use innovative technologies to create a cost effective, open source chromatography (OSC) system. An ideal system should provide equally high purity and have similar functions to the commercial system, which would be very beneficial. It would be highly beneficial as an educational tool in high schools because it allows chemistry and biology to complement their classroom lecture with hands-on lab experiments. In addition, the OSC system might also be used as an alternative to commercial systems in research labs and pharmaceutical companies. The OSC system's low cost would significantly reduce protein purification costs while maintaining quality; allowing manufacturers to potentially reduce drug prices and make medications more affordable for patients.

New technologies like Arduinos and 3D Printing have made this project possible. The Arduino is an easy to use, open-source prototyping platform which was used to drive the entire system. An Objet 3D printer was used to create custom parts for the OSC system (flow cells and a syringe pump). First of all, a syringe pump was designed in Autodesk Inventor and an Arduino was used to control the pump motor. The finished pump was then connected to a glass column that contained a chromatography resin for protein purification. The fluid leaving the column then passed through pH and conductivity sensors that were also connected to the Arduino. These variables are commonly used in commercial chromatography systems to monitor the column effluent to detect when impurities are leaving the column. The Arduino monitored the sensor readings and displayed pH and conductivity readings for the user. The pH and conductivity meters were already available at low cost online, but flow cells were designed on Autodesk Inventor and printed to minimize the amount of liquid flowing past a sensor at any given time. Finally, we attempted to add a UV sensor to determine when proteins are leaving the column, but the UV LED used proved to be far too weak and stronger LEDs were much more expensive.

Overall, a working prototype of the OSC system has been completed that costs around $550. The current system created can already be used to reduce ion concentrations in water, which could be implemented to purify water in third world countries with limited access to clean water. The syringe pump can successfully pump the solution through the column, although it currently works in short pulses instead of a continuous flow. We are currently working to upgrade the pump to provide that functionality. Additionally, both the conductivity and pH sensors have been calibrated, connected to the Arduino, and tested. Multiple trial runs have proven that the sensors can detect changes in both salt concentration and pH in the column. In future work, a blue light absorbance sensor will be added in place of a UV-Visible absorbance to detect proteins that absorb blue light (e.g. hemoglobin).

C-44: Producing a stable blood substitute from earthworm hemoglobin
Author: Matthew Dilusto
Advisor: Dr. Jacob Elmer

Donated human blood is effective, but it has some limitations such as its storage and shelf-life. For example, donated blood must be refrigerated at 4°C and only lasts up to 42 days. The motivation for this research project is develop a blood substitute with higher stability with higher stability and longer shelf life, so it can be used on a military battlefield where donated blood is unavailable. Since the most important function of blood is to transport oxygen throughout the body, the oxygen transport protein

human hemoglobin (HbA) is typically used in the development of a blood substitute. However, there are a few major problems with HbA, including nitric oxide scavenging, which causes high blood pressure. Consequently, the shift from human hemoglobin to earthworm hemoglobin, also known as erythrocruorins (Ecs), was made. The Elmer lab studied the common Canadian nightcrawler Lumbricus terrestris (LtEc) and was found to be naturally extracellular, to not have red blood cells (RBCs) and to transfuse safely in vivo trials with hamsters without any of the side effects observed with mammalian Hbs.

The purpose of this project is to determine which invertebrate hemoglobin is the best candidate to use as a stable blood substitute. Six erythrocruorins were tested: Eisenia fetida (EfEc), Eisenia veneta (EvEc), Eisenia hortensis (EhEc), Amynthus gracilus (AgEc), Eudrilius eugeniae (EeEc). All of these terrestrial earthworms are closely related to LtEc and are commercially available so they should be economically feasible and affordable as blood substitutes. The end goal is to produce a stable blood substitute that can withstand high temperatures, has a low oxidation rate (slow rate of converting from Fe2+ --> Fe3+, which doesn't bind O2), and have high oxygen affinity. A thermal shift assay was performed to determine which Ec denatured at the highest temperature; in other words, which Ec is the most stable. An oxidation assay was performed to find which Ec oxidized at the slowest rate, and thus was still able to transport oxygen throughout the body after storage.

After running the thermal shift assay, the data shows that EeEc denatures at 48°C, which is significantly lower than the temperature LtEc denatures at (51.9°C). On the other hand, EvEc denatures at 56.6°C, which is significantly higher than LtEc. We found the oxidation rates of the Ecs were heavily dependent on the absence or presence of antioxidants. For example, in the absence of antioxidants, LtEc oxidizes the fastest (reaching 100% Fe3+ after just two days) while all the Ecs have slower oxidation rates. In contrast, when antioxidants were added, LtEc had the lowest oxidation rate. Finally, LtEc has unusually low oxygen affinity (P50=38.5mmHg), compared to other Ecs which have higher oxygen affinities (P50=12-14mmHg). Thus, while LtEc is relatively stable, it appears that EvEc might be a little bit more so. Moving forward, LtEc and EvEc would be the best candidates for animal trials and are the most stable Ecs, thus it would be easiest to deploy them as blood substitutes in military use.

C-45: Evaluating the impact of natural coagulants on the formation of disinfection byproducts
Author: Jingxian Wang
Advisor: Dr. Wenqing Xu

Disinfection byproducts (DBPs) are toxic chemicals formed by chlorine during the disinfection process. The potential of using natural coagulants to mitigate the formation of DBPs will be investigated in this research. Project will be divided into three main parts. First, analytical methods will be developed for selected DBPs: two classes of selected DBPs will be measured by Gas Chromatography with Mass Spectrometer detector and analyzed by method of Chinn and EPA method 521 respectively. Second, optimum dose for coagulation will be determined: water samples will be collected from effluent of a wastewater treatment plant; jar tests will be conducted to determine the optimum doses for two natural coagulants and one traditional coagulant. Third, the formation of DBPs will be quantified: water samples will be treated for chlorination and chloramination after being filtered; the amount of formed DBPs will be measured according to the analytical method developed in the first part. This project will compare the efficiency of reducing the formation of DBPs for both natural and traditional coagulants and potentially provide an alternative method to minimize the formation of DBPs.

C-46: Virtual education system

Authors: Matthew Wood, John Aquino, David Lewis, and Noah Schwanke
Advisor: Dr. Edmond Dougherty

The primary goal of the Virtual Education System or (VES) is to develop software that individuals use to interact with three dimensional images in space. The project includes hardware, but it is primarily a software and experimental courseware development project. VES enhances the education of the students because they are able to understand complex three dimensional concepts in three dimensions. Before VES, inadequate tools such as white boards, chalkboards, and SmartBoards all created two dimensional images for three dimensional topics restricting the ability for many students to get a full vision of many topics, especially those relating to STEM. VES provides a cost-efficient and interactive solution to this problem.

VES is a product that allows the student to view not exclusively the X and Y-axis, but the Z-axis as well. It shows a three dimensional image in space, similar to a hologram, that can be interacted with by the user in order to effectively help all types of learners. Throughout research, three types of learners were identified: auditory, visual, and kinesthetic.The classic classroom setting has always favored the Auditory learner with lectures, lesson plans, and note taking. Visual learners have had help with white board drawings and projections. However, kinesthetic learners have often been left out to dry with little interaction. There is no technology on the market that encompasses the needs of these students in a way that will effectively enhance education until now with the VES. Several lessons can be adapted to use VES. Over the summer a volume lesson was created in order to showcase the value and opportunity that VES can offer in the classroom.

C-47: Hydrologic influences on surface peat characteristics at the great dismal swamp: implications for carbon storage and fire vulnerability

Authors: Bridget Gile, Morgan Schulte, and Dr. Daniel McLaughlin
Advisor: Dr. Daniel McLaughlin

Peatland ecosystems are a critical environmental resource for biodiversity and global carbon sequestration; drainage of peatlands for agricultural, residential, and commercial development can severely impair these functions. The purpose of this research was to examine the influence of wetland hydrology on physical and chemical properties of surface peat that indicate its degree of decomposition and affect its vulnerability to fire. Peat cores were collected from the Great Dismal Swamp at 20 locations along a hydrologic gradient and analyzed for bulk density, organic matter content, and carbon/nitrogen concentrations. These soil properties were evaluated against mean water levels at each sampling location to assess hydrologic controls on peat characteristics. Excluding an outlier transect, peat bulk density and organic bulk density were found to decrease significantly with increased wetness. Nitrogen concentration was positively correlated with mean water level, while organic matter fraction and carbon content appeared to be influenced significantly by factors other than hydrologic regime. Evaluated soil parameters serve as important indicators of peat decomposition, as well as influence the vulnerability to peat-consuming fires, both of which have implications for carbon storage. Understanding the hydrologic controls on these parameters at the Great Dismal Swamp will not only aid in the assessment of current conditions, but also will serve to guide ongoing restoration efforts focused on rewetting the Swamp.

C-48: Observation of ice formation in C. elegans as a model for organ cryopreservation
Authors: Scott Leighow, Dr. Matthew Youngman, Dr. Jens Karlsson
Advisor: Dr. Jens Karlsson

Intracellular ice formation represents a major obstacle in the development of effective cryopreservation techniques for tissues and organs. Therefore, in this study, nematodes (C. elegans) were used in freezing experiments as a model for complex, multicellular tissues such as human organs. The formation and propagation of inter- and intracellular ice in C. elegans was visualized using high-speed video microscopy. C. elegans were harvested, mounted onto a cryomicroscope, and cooled to subzero temperatures in order to observe ice formation within the worm tissue. The procedure was executed at various cooling rates and for all larval stages of C. elegans. In all experiments, the initial site of appearance of ice within the animal was consistently located adjacent to the pharyngeal cavity. The ice solidification front was then observed to propagate in a wave that traveled in the anterior-to-posterior direction. In most experiments, a secondary wave of ice propagation was also observed, usually beginning at the mouth and terminating at the posterior end of the foregut. With further quantitative analysis, it may be possible to elucidate the mechanisms of freezing and cryoinjury in this multicellular model organism, yielding valuable insights to guide the development of cryopreservation methods for clinically relevant tissues and organs.

D-49: Reducing complications following esophageal endoscopic surgeries with photo-crosslinking treatment
Authors: Zachary Ellenhorn, Michael McCormack, and Dr. Robert Redmond
Advisor: Dr. Robert Redmond

There are an estimated 16,910 new cases and 15,690 deaths due to esophageal cancer every year. Until recently, the standard of care for definitive treatment for cancers of the gastrointestinal tract has involved major open surgical resections. However, for pre-malignant and early stage cancers, minimally invasive endoscopic resection is now possible. Endoscopic mucosal resection (EMR) and Endoscopic submucosal dissection (ESD) are procedures currently in use for minimally invasive resection of pre-malignant and early stage cancers. EMR is used for removal of superficial lesions, and ESD for deeper resection. Unfortunately, both of these procedures have potentially significant complications. The most common complication is post-procedural stricture occurring in 6-88% of patients after resection. When the stricture decreases luminal size to a significant degree, the implications are life-limiting for patients and it requires treatment through multiple serial dilation procedures for treatment. Another common complication is perforation, which occurs during 2.3-4.6% of these procedures. If the perforation is not adequately repaired at the time of perforation, the patient will become critically ill and require an emergent surgical procedure.

These complications arise due to the surgical thinning, and therefore, weakening, of the tissue. On occasion, there are also accidental perforations made during surgical procedure. The current standard of care for this is to seal the opening with a clip. The methods that could strengthen the tissue or securely mend a perforation would be valuable.

Photo-crosslinking (PXL) is a platform technology developed in our laboratory that has been shown to have a multitude of utilities, including tissue reinforcement by the process of cross-linking collagen, and prevention of inflammation and scarring. The process of PXL involves painting a photosensitizing dye, Rose Bengal (RB) onto tissue and then exposing the tissue to green light; this induces collagen cross linking in the tissue. This can either be used to strengthen tissue or for wound

closure between two tissue surfaces. PXL could resolve a number of the complications that arise due to ESD by strengthening tissue or sealing a perforation.

D-50: Development of a heterogeneous autonomous vehicle laboratory
Authors: Matthew Kerlin and Kevin Kan
Advisor: Dr. Hashem Ashrafiuon

The purpose of this research project is to further establish the development of a laboratory where various types of autonomous vehicles can effectively communicate and work together. The lab is intended to advance research in the field of heterogeneous autonomous vehicle coordination for implementation in real-world applications. Currently, there are limited resources available which clearly explain how to develop a heterogeneous autonomous vehicle lab. It is the goal of this project to provide a useful reference and guide for any future autonomous vehicle laboratory development. Furthermore, it is a goal to achieve the full development of an indoor lab environment where autonomous ground and air vehicles can collaborate to perform common missions. The lab vehicles are all designed with the capability to add additional sensors for future research. Numerous experiments were conducted to calibrate sensors, control actuators, resolve communication issues and ultimately, demonstrate the capabilities of the lab and its vehicles. Our research during the summer of 2016 focused on closed control to maintain mobile robot wheel speeds and wireless communication delays.

D-51: Sub-critical hydrothermal pyrolysis of wet biomass for the production of bio-oil and biochar
Authors: Hyo S. Won and Dr. Justinus A. Satrio
Advisor: Dr. Justinus A. Satrio

Organic waste is a major component of landfills, which is the largest source of methane emission, in the USA. From the food supply chain system alone (i.e. from harvesting to consumption, excluding the non-edible parts), 30-40% of the food is wasted, equaling more than 35 million tons per year or approximately 240 pounds of food per year per person. Finding ways to utilize this wet organic waste into useful products will be desirable from both economic and environmental sustainability point of view. In this project, a thermochemical process called sub-critical hydrothermal pyrolysis (HTP) is used for converting biomass, immersed in water, into liquid bio-oil and solid biochar which subsequently can be used as intermediate feedstock for the production of end products, such as biofuels and activated carbon, respectively. During the hydrothermal liquefaction process, slurry of biomass material (5-20wt% in water), is subjected to elevated temperatures (180-350oC) for a period of time (2 – 50 hours) under sub-critical conditions in order to break down and reform the chemical building blocks into a solid (biochar), a liquid (bio-oil) and non-condensable gas mixture products. Under sub-critical condition, water will stay in liquid form and act as a reaction media to promote the breakdown and cleavage of chemical bonds in the solid biomass. The absence of liquid-to-vapor phase change of the water make the process significantly less energy intensive compared the process that involves water vaporization. The relative yields and the properties of bio-oil and biochar products are dependent on the process temperature and heating time. When the desired main product is biochar, the pyrolysis process is conducted at lower temperature, typically between 180 and 230oC. The HTP process is suitable for biomass feedstocks which have high moisture content, such as food wastes and municipal solid wastes. To be presented is the preliminary results of hydrothermal pyrolysis by using spent mushroom substrates. This project is part of the collaborative efforts of Villanova University

with Gray-Brothers-Samax Environmental Company in the development of a biorefinery system for converting solid waste for the production of useful bio-based products, which is economically and environmentally feasible.

D-52: AtmoGEN
Authors: Andrew Meluch, Bryan Ramirez, Stephanie Krakower, and Mackenzie Bowden
Advisor: Jordan Ermillo

For the past two years, the remote southern region of Madagascar has been negatively affected by severe droughts. The region is extremely hot and humid, but the large amounts of water in the air never condense. Water scarcity has not only left people without enough water for daily tasks like cooking and bathing, but has also led to food shortages caused by lack of irrigation. These shortages have forced people to resort to eating their seeds rather than planting them, and selling the clothes off their backs in order to barely afford expensive, dwindling supplies of bottled water. Catholic Relief Services (CRS) in Madagascar approached Villanova Engineering Service Learning (VESL) and asked that research be done to develop a technology to address this humanitarian issue. Our solution is AtmoGEN, a sustainable, efficient atmospheric water generator that uses the natural processes of solar heating and natural convection, combined with the innovative technology of 3D printing, to extract moisture from the air.

D-53: Comparing the effects of feedstock on the yields and selectivity of bio-oil products from catalytic pyrolysis of biomass using Sr-ZSM-5 and H-ZSM-5
Authors: Gregory Zakem, Brendan Shea, Dr. Justinus Satrio, Dr. Charles Coe
Advisor: Dr. Justinus Satrio

Fast pyrolysis is a thermochemical conversion process in which biomass is decomposed to produce a liquid (bio-oil), a solid (bio-char), and a non-condensable gas mixture (syngas) by exposing biomass to high temperatures, typically between 400 and 600oC, in the absence of oxygen. Bio-oil, which is typically the primary product of fast pyrolysis consists of hundreds chemical compounds having various chemical functionality groups. The yields and selectivity of chemical compounds in bio-oil are highly dependent on pyrolysis process conditions, catalysts compositions (if present) and physicochemical properties of the feedstock. The oxygenated compounds, primarily acids, aldehydes and ketones, render bio-oil unstable and highly acidic. Pyrolyzing biomass in the presence of solid acid catalyst, such as ZSM-5, promotes the production of aromatics, making the produced bio-oil more stable. In this work, catalytic pyrolysis studies by using 4 different biomass feedstock, i.e. pinewood (PW), switchgrass (SG), phragmites (PHRAG), and manure-containing bedding material (MAN) from a horse farm have been conducted. Two different zeolite catalysts both Si/Al=40, i.e. H-ZSM5 (40) [Brönsted acid] and Sr-ZSM5 (40 [Lewis acid], were tested. The goal of this project is to determine which biomass feedstock and which catalyst is most effective at producing high yields of non-oxygenated hydrocarbons, primarily aromatics, such as benzene, toluene and xylenes.

English

D-54: An Augustinian Analysis of Vocation in a Secular Age
Author: Kaitlyn Stepanek
Advisor: Dr. Michael Tomko

Charles Taylor defines a secular age as one inhabited by buffered individuals, or individuals who understand that fulfillment can be found within the immanent frame. These buffered selves seek fulfillment, and take for granted that fulfillment can be found, within the context of human achievement and that beyond this, there is nothing.

By this logic, an audience of buffered selves would be uninterested in a character like John Milton's Jesus in "Paradise Regained." The Messianic figure has the potential to find fulfillment, in the buffered individual's sense of the word, arguably the highest potential for human achievement as He has the added bonus of also being fully divine. However, with all of the potential the audience knows he has, Jesus does close to nothing, and from the buffered perspective, is a failure. Christ denies his own potential to be in control and to wait for God's plan to be revealed. For Charles Taylor, this type of person is known as a porous individual as they receive their meaning and fulfillment from outside of themselves and believe these can come from outside of the immanent frame. Christ, as a porous self, recognizes and waits for grace as the fulfillment of his vocation. Certainly, a story that claims grace is the only part of a human life that can be counted for good and lead to fulfillment would be unfathomable to a buffered individual in today's secular age.

And yet, so many in this supposedly secular age have identified with characters like Katniss Everdeen from *The Hunger Games*, who subscribes fully to the idea that fulfillment is found within Charles Taylor's immanent frame and reflects on her life as restless and unsatisfied as a result, and Harry Potter, who faces and opposes the temptations of worldly success that Milton's Messiah faced for a fulfillment outside of this world. Taylor may argue that the secular audience would have no interest in Harry as he consistently rejects opportunities to wield earthly power or relish in his popularity in the wizarding world. Instead, Harry choses to die. Fulfillment found in death does not belong in the secular age, and yet so many living in this age seem to identify with the choices of Harry. Charles Taylor's Secular Age misses a key restlessness among young people that the unsatisfying ending of *The Hunger Games* and their affiliation with Harry Potter illuminates.

D-55: A Tragedy of Faith: Echoes of Kierkegaard in Faulkner's *The Sound and the Fury*
Author: Luke Hensley
Advisor: Dr. Jean Lutes

Critics have written extensively on the importance or of religion in Faulkner's *The Sound and the Fury*, especially in reference to the southern Baptist culture in which Faulkner was raised. However, given Faulkner's relative lack of exposure to theologians of other cultures and time periods, few scholars have suggested parallels—either intentional or incidental—between Faulkner and other religious thinkers, especially non-American ones. Despite having no biographical link to Faulkner, Danish theologian Soren Kierkegaard seems to sympathize with many of Faulkner's ideas about religion, mortality and selfhood. By reading *The Sound and the Fury* through the lens of Kierkegaard's writings, we can both gain insight into the novel's multiple perspectives on the religious life and begin to situate Faulkner within the Christian existentialist tradition.

Environmental Science

D-56: Adsorption of chlorantraniliprole: which soil factors affect sorbent affinity?
Authors: Cara Mathers, Dr. Travis Gannon, Ling Ou, and Khalied Ahmed
Advisor: Dr. Travis Gannon

Structural termite damage and control costs average $5 billion USD yr-1 in the United States, which is in part due to labor-intensive control practices currently employed such as soil-injection or trenching. Surface termiticide application on soil surrounding structures could offer a simpler, cost-efficient alternative to injecting/trenching. Previous research has shown downward soil distribution of the termiticide, chlorantraniliprole, can be improved via increasing application carrier volume and the use of soil surfactants; however, results varied across soils of varying textures (clay or sand) and organic matter contents (low [1-2% w w-1] and moderate [3-5%]). Laboratory research was initiated to determine the degree to which certain soil texture and organic matter concentration affect chlorantraniliprole-soil sorption. Four soil textures (clay, clay loam, sand, or silt loam) were evaluated at two soil organic matter contents (native amount or native + 2.5% w w-1). Chlorantraniprole was spiked at 0, 1, 2, 4, 8, or 12 mg kg-1, and the parent compound was quantified 24 h later using high performance liquid chromatograph-diode array detector-mass spectroscopy methodology to develop chlorantraniliprole-soil sorption isotherms.

D-57: Azteca trigona influence species distribution and ant behavior in a lowland tropical forest
Authors: Kate Henderson, Jane Lucas, and Dr. Michael Kaspari
Advisor: Dr. Michael Kaspari

Tropical ants have major impacts on their surrounding ecosystems. Insect waste acts as an important nutrient cycling link between the canopy and the forest floor; due to their large, long-lasting colonies, ants make a good study species for examining how insect excreta may impact habitat heterogeneity, plant growth, and other processes in tropical forests. Additionally, this refuse can contain chemicals and pheromones that other organisms may respond to. This study took place in Barro Colorado National Monument, Panama, and focused on Azteca trigona ants. A. trigona are a common, aggressive species of arboreal ant whose colonies drive habitat heterogeneity by creating nutrient-rich waste patches across the forest floor. The study aimed to address three major questions: 1) whether A. trigona nests impact the growth of Ochroma pyramidale tree seedlings, 2) whether the presence of A. trigona refuse or nest material impacts the behavior of other ants, building into 3) what overall impact Azteca trigona have on species distribution in a lowland tropical forest. When 80 Ochroma seedlings were placed in the forest during the summer of 2016 at locations either under or ten meters away from A. trigona nests, no difference in seedling growth or survival was observed. This contrasted with a greenhouse study in 2015, which found that seedling growth was significantly higher when A. trigona refuse was present; some factor in the field is inhibiting seedling growth and preventing seedlings from offering the ants' host tree increased competition for the nutrient-rich refuse. The second portion of the study, recording the reactions of Eciton spp. army ants and Atta colombica leafcutter ants to different materials being placed in their path, found that the army ants strongly avoided A. trigona nest material and avoided A. trigona refuse in comparison to a control. This finding is very important to species distribution in a forest, since army ants are aggressive predators that feed on a variety of insects (some of which Azteca trigona do not attack when they are present near A. trigona nests). These results imply that the presence of Azteca trigona nests is one driver of species

distribution in the tropical lowland forest of Barro Colorado Island-- the nutrients in the refuse benefit the host tree but do not lead to increased competition from seedlings, while chemicals and pheromones in the refuse deter army ants and may therefore offer protection for other insect species.

D-58: Salt marsh plant competition study
Author: Olivia Cacciatore
Advisor: Dr. Nathaniel Weston

One of the most concerning side effects of global climate change are rising sea levels. As glacial ice melts, the sea level rises, endangering coastal ecosystems like saltwater marshes. Macrophytic plant species like Spartina alternaflora and Typha augustifolia maintain coastal ecosystems and combat the rising sea levels that can erode tidal creek banks. The preservation of these salt marsh ecosystems are important for their role in wave attenuation . A side effect of the erosion of these ecosystems is saltwater intrusion and conversion of freshwater systems to brackish environments. While some coastal plant life is reasonably salt tolerant, many rely on minimally brackish or freshwater conditions, and cannot tolerate high levels of salinity. As the base of the ecosystem, the survival and condition of plant life is very important to the overall health of the ecosystem.

For this experiment, identified two different plant species to use to examine the potential negative effects of saltwater intrusion, S. alternaflora and T. augustifolia. The goal of this experiment was to see if changing salinity would have a negative impact on the survival and/or recorded biomass of S. alternaflora and T. augustifolia species over time, and to determine at which salinity would competition between the two species become a significant factor in survival for either.

I removed plants of each species from their natural salt marsh habitat in Plum Island, Massachusetts and transplanted them to a greenhouse environment, where they were subjected to different concentrations of saltwater, both as solitary plants and in a competitive space. At regular intervals, the plants were measured for height, and at the conclusion of the experiment, were harvested, dried, and massed for biomass calculation.

My experiment showed that, while S. alternaflora was capable of growth across all ranges of salinity, it grew best in lower salinity environments. It was, however, influenced by competition, and in a natural environment, the growth of dense T. augustifolia at lower salinities would likely prevent the growth or colonization of S. alternaflora. On the other hand, the survivorship of the T. augustifolia did not appear to be affected be competition, but rather on salinity. The T. augustifolia could not survive higher salinities for the duration of the experiment.

From the experiment's results, I can conclude that as saltwater intrusion into freshwater ecosystems continues, there will first be competition between the two species, in which T. augustifolia populations would likely win, before yielding to the extremely salt tolerant S. alternaflora populations as salinity continued to rise. If saltwater intrusion were to continue, we could see the disappearance of brackish or freshwater species from coastal marsh ecosystems, leaving the tidal creek bank bare and in danger of further erosion, and eliminating the natural buffering services of coastal salt marsh ecosystems.

D-59: Identifying controls on triclosan loading to the East Branch of the Brandywine Creek
Authors: Gina Talamo, Garrett Waligroski, Mary Frances Barr, and Amanda M. Grannas
Advisor: Dr. Steven Goldsmith

Emerging contaminants, especially those associated with pharmaceutical and personal care products, have become a growing area of concern for our waterways during recent years. Triclosan, a commonly

used antibacterial agent, is one such contaminant. However, previous studies have only focused on environmental concentrations of triclosan in areas immediately downstream of municipal wastewater treatment plants (WWTPs) or in WWTP effluent, thus overlooking potential inputs from other point sources such as small, privately operated sewage systems and non-point sources (i.e., leach fields associated with septic systems). This study addresses these knowledge gaps by evaluating the range of concentrations and overall controls on triclosan delivery to the East Branch of the Brandywine Creek (EBBC), a rural to suburban watershed located in southeastern Pennsylvania. A total of 29 water samples and discharge measurements were collected throughout the watershed in June 2016 during baseflow conditions. A subset of samples was collected directly above and below 10 National Pollutant Discharge Elimination Systems (NPDES) in the watershed, which are associated with small, privately operated WWTPs. Other samples were collected from tributaries with no NPDES sites to determine whether leach fields are a potential triclosan source. Instantaneous triclosan loads and yields calculated for each portion of the watershed were subsequently compared to a variety of factors, including GIS-determined land use practices, the number of NPDES permit sites and the permitted flux of triclosan above each of the sampling locations in order to determine controls on its input to the watershed. Finally, triclosan loading associated with a municipal WWTP in the lower portion of the watershed was compared with the cumulative value determined for the upstream areas in an effort to identify the role of the smaller, "non-traditional" NPDES sources on total triclosan delivery to the watershed.

D-60: The response of estuarine metabolism to changes in tidal marsh elevation due to sea level rise

Author: Mikala Jordan
Advisor: Dr. Nathaniel Weston

Estuaries are highly productive systems that provide numerous ecosystem services beneficial to humans and the environment. Nutrients flow from marsh-draining tidal creeks in the surrounding marshland watershed into estuarine ecosystems. As the climate changes, marshes are at risk of permanent inundation if they cannot keep pace with sea-level rise. The marsh-estuary ecosystem in Plum Island Sound, Massachusetts, includes two distinct types of tidal marsh: high-elevation marsh (dominated by the plant Spartina patens) and low-elevation marsh (dominated by S. alterniflora). We predicted that Plum Island's ecosystem faces a net loss of marshland, and that much of the high-elevation marsh will be transitioning to a low-elevation marsh system due to rising sea levels. My major research question is: Does the transition from high-elevation marsh to low-elevation marsh drive differences in production and respiration in the estuary water-column? Differences in the plant species composition and the duration of flooding in the marsh types will likely affect the organic matter and nutrient loads entering the estuary. As Plum Island's marshes transition, there will be greater connectivity between marsh and estuary brought about by greater frequency and duration of flooding.

My experiment tested how the connectivity between flood water and high and low marshes fuels metabolism in the water column. To do this, I took large volume water samples from two creeks draining high marsh and two creeks draining low marsh on the falling tide on four different dates. For each sampling, I incubated the collected water at 4 different light levels and measured the change in dissolved oxygen. I hypothesized that rates of both photosynthesis (oxygen production under lighted conditions) and respiration (oxygen consumption under darkened conditions) would be higher in estuarine waters draining low-elevation marshes, but that increases in respiration would be proportionally higher, leading to increased net heterotrophy. Contrastingly, I found that production was significantly higher in the creeks draining high marshes for two of the four samplings in mid-

summer. I observed seasonal influence on patterns of oxygen production across both types of marsh. As more marshes transition to low-elevation marshes in response to sea level rise and productivity in estuarine water declines in response, we may expect a trophic cascade arising from decreases in the net primary production of the ecosystem. This holds implications for the continued success of the marsh-estuary ecosystem at Plum Island.

D-61: Montipora capitata survivorship: the importance of photosynthesis in coral development

Authors: Meghan McMahon, Jacqueline Padilla-Gamiño, and Dr. Lisa Rodrigues
Advisor: Dr. Lisa Rodrigues

Coral reefs are important to marine ecosystems because they support high biological diversity and serve as a natural barrier for coastal regions during storm events. Unfortunately, corals have been dying due to a rise in global seawater temperatures, which results in bleaching or a loss of endoymbiotic algae, reducing photosynthesis in adult corals. However, how increased temperatures affect coral larvae is not well known. In this study, we focused on the larvae of Montipora capitata, a common Hawaiian reef-builder. To determine the importance of the zooxanthellae within the first stages of coral life, we maintained groups of larvae in light and dark treatment bottles for 12 days. During that time, water was cleaned by reverse filtration and the larvae were examined under a microscope to determine survivorship and coral development. As hypothesized, the two dark treatments had lower survivorship rates (0% and 0.06%) than those of the two light treatments (0.13% and 1.5%). However, this may have been due to higher temperatures in dark treatment bottles in addition to the lack photosynthesis of the coral larvae.

D-62: Evaluating the relationship among land use change and nutrient export with nearshore coral health in southern Puerto Rico

Authors: Devin Smith, Dr. Lisa Rodrigues, Dr. Eric J. Wagner, Dr. Peleg Kremer, Ryan Moyer, and Dr. Steven T. Goldsmith
Advisor: Dr. Steven T. Goldsmith

The coral reefs of Guánica Bay along the southwest coast of Puerto Rico are believed to be severely degraded due to influxes of sediment and nutrients from the adjacent Rio Loco watershed. Over the last several decades, land degradation in the headwater regions of the watershed, largely associated with agricultural and pastoral practices, has created an ideal situation for sediment mobilization triggered by intense precipitation events. This study seeks to evaluate the long-term relationship (1991-2015) between land cover and land use alteration with sediment and nutrient export in the Rio Loco watershed and nearshore coral health in the adjacent Guánica Bay through use of the following: 1) analysis of historical land use data from the USDA Forest Service, GAP Analysis and National Land Cover Database (NLCD), 2) calculation of sediment and nutrient yields using historical USGS datasets, and 3) determination of annual growth band width in previously collected coral cores (sp. Montastrea faveolata) from three near-shore reef sites in Guánica Bay. The sediment and nutrient flux data will also be compared with existing NOAA precipitation data for the same period to identify rainfall thresholds capable of producing large scale sediment export events. Data obtained from this study will be of great use to resource managers with regards to mitigation and/or conservation measures designed to protect coastal areas.

D-63: Respiration and potential denitrification in tidal marsh soils

Author: Diana Lampasona
Advisor: Dr. Nathaniel Weston

Denitrification is the anaerobic reduction of nitrogen oxides [nitrate (NO3-)] and nitrite (NO2-)] to nitrogenous gases [nitrous oxide (N2O) and nitrogen gas (N2)] by microbes in soils and sediments. Nitrogen is often limiting for production in ecosystems, however human inputs of nitrogen through use of fertilizers and other sources have increased the amount of reactive nitrogen globally. Increased nitrogen availability has accelerated rates of denitrification in many systems. Increased denitrification leads to larger N removal, an important ecosystem service. It also leads to increased N2O production, a greenhouse and ozone depleting gas. Excess nitrogen from human activities enters the coastal zone and denitrification in tidal marsh ecosystems acts as an important filter for watershed-derived nitrogen. Tidal marshes are productive ecosystems that have the potential to remove large amounts of nitrogen. Tidal marshes may not keep pace with accelerating rates of sea-level that are predicted for the next century, leading to increased tidal flooding durations. Greater flooding in tidal marshes may alter the plant community and rates of plant production, as well as the oxidation state of soils. Increasingly anoxic soils resulting from limited reoxidation of soils will favor anaerobic processes, potentially decreasing rates of denitrification. Sea-level rise may therefore result in decreases in denitrification, an important ecosystem service that tidal marshes provide.

The goal of this study is to investigate how rates of denitrification and total soil respiration respond to changes in tidal flooding. In order to address this question, my study focused on a tidal marsh system in Plum Island, Massachusetts. Two transects in high elevation marsh and two in low elevation marsh, with three plots (creek-bank, middle marsh, and interior marsh) were established. Soil cores were taken at each plot three times throughout the summer. Each core was divided into two incubation jars, flushed with nitrogen gas to create an anoxic environment, and treated with acetylene gas in order to inhibit the enzyme that reduced N2O to N2, such that N2O accumulated at a rate equal to denitrification. Gas samples were taken at four time points and analyzed on the gas chromatograph for N2O (as a measure of denitrification) and CO2 (as a measure of total soil respiration). I found that rates of denitrification generally decreased from creekbank to interior marshes. Throughout the summer, rates of denitrification ranged from 0.05 to 0.60 nmol cm-3 hr-1 and rates were fairly similar at the three sampling times, with the last sampling date in August being lower than the first two. Rates of total soil respiration ranged from 5 to 100 nmol cm-3 hr-1, indicating that denitrification was a small fraction (~1%) of total soil respiration. Total soil respiration was significantly related to belowground biomass of marsh plants, suggesting that belowground plant production and soil respiration are closely linked. Denitrification did not appear to differ between high- and low-elevation marshes dominated by different plant species, suggesting that increased flooding and transition from the current high-elevation marsh platform to a marsh system more dominated by low-elevation marshes may not directly influence denitrification as an ecosystem service.

History

D-64: The 'Youth' of the World on Hitler's Stage: United States Race Relations and the Movement to Boycott the 1936 Berlin Olympics
Author: Kathleen Boyce
Advisor: Dr. Paul Steege

The dominant narrative of the 1936 Berlin Olympics in Nazi Germany has placed Jesse Owens as the hero who triumphed over the Nazis' racist agenda. This examination of the 1936 Games is a story about race relations in the United States. My research has focused on John Woodruff, a black 19-year-old who won gold in the 800m run in Berlin. My research looks at Woodruff along with several other American athletes.

Many Americans saw the 1936 Olympics as a moment of moral superiority for the United States over the Nazis through the strong representation of black athletes in close contradiction with the racism of Nazi Germany. However, a closer look reveals how underlying racism in the United States shaped the U.S. participation in the Games.

Language used during the boycott debate can reveal racist beliefs toward different athletes. The term "youth" is frequently used in discussion on the Olympic boycott movement when the Olympic organizing committees, predominantly made up of wealthy, older, white, men, discuss the athletes. The term youth is an ambiguous term that both celebrates energy and athleticism, but at the same time denies full adult status to the athletes. The use of the word youth implies a hierarchy between the athletes and Olympic committee members, especially when used toward black athletes in the United States.

To address these questions and to investigate American racism in relation to contemporary American perceptions of Nazi racism, I traveled to several archives. At the Princeton University Archives I examined documents on Princeton athletes and a member of the American Olympic Committee, Joseph Raycroft. The University of Pennsylvania archives held information on the popularity of track and field in the run-up to the 1936 Games. The *Daily Pennsylvanian* published articles advertising forums on the boycott of the Olympics. The United States Holocaust Memorial Museum in Washington D.C. held a wide variety of sources on the American boycott movement from newspapers, to letters, speeches, and the German efforts to stop the progression of the American boycott movement. I scrolled through microfilm files from the National Association for the Advancement of Colored People (NAACP), which held a variety of sources such as newspapers, speeches, and correspondences. Lastly, I read articles from 1935 and 1936 newspaper publications such as *The New York Times*. These many sources all help to frame the U.S. debate on the 1936 Olympics from the perspective of American everyday racism.

Nursing

E-65: High school students and risk taking behaviors: is there a relationship between health risks and online risks?
Author: Catherine DeLuca
Advisor: Dr. Elizabeth Dowdell

Background/Purpose: Three in four adolescents today have access to a smart phone or computer, and it only takes the click of a button to send something they might regret. Adolescents are taking nude

photos of themselves then sending them on their cell phones or posting them online, a practice now known as "sexting". These images can be posted using applications or social media sites like SnapChat, Facebook, Instagram, and iMessage. This type of self-exploitation can have long-term implications for this young and inexperienced population. The purpose of this study is to examine risk behaviors of health and Internet use reported by high school students who send or receive sexting messages on their cell phones.

Methods: A secondary analysis from a 2012 data set containing quantitative data from 5,437 students found 47.2% reported to sexting. Descriptive statistics were used on the sample that sexted, which contained more girls (53%) than boys (47%).

Results: Findings revealed that the behavior of sexting has a significant relationship ($p < .0001$) with other internet risk behaviors, such as viewing sexually explicit material, going onto online sex sites, and posting sexual or inappropriate photos online. There is also a relationship between sexting and health risk behaviors such as alcohol consumption and drug usage. The sending and receiving of sexting messages also has a significant relationship with physical and electronic aggression.

Conclusion & Implications: Participation in certain risky behaviors online and offline are of concern. Findings from this study suggest important areas of intervention with teens who partake in sexting behaviors. Specifically, interdisciplinary educational programs that focus on prevention, risk reduction, and safety as well as implementing an evidenced-based practice model that incorporates a screening tool, brief interventions, and referrals for treatment for at-risk students with correlational risky behavior.

E-66: Just in KASE: evaluating nursing students' knowledge, attitudes and self-efficacy to care for the dying patient

Authors: Emma Max and Dr. Meredith MacKenzie
Advisor: Dr. Meredith MacKenzie

Introduction: Caring for the dying patient can be distressing for nursing students. End of life (EOL) care is an essential skill for the professional nurse and the nursing student must prepare to provide quality care to these patients, while maintaining their own emotional health. Little is known about current student nurse knowledge, self-efficacy or attitudes towards EOL care.

Aim: Describe the knowledge, self-efficacy, and attitudes towards EOL care among nursing students at a northeastern traditional baccalaureate program and examine correlations between student demographics and outcomes .

Methods: Nursing students from the sophomore to senior levels were sent an online survey consisting of demographic questions, the Frommelt Attitude Toward Care of the Dying (FATCOD), the Knowledge Assessment, and Self-Efficacy Assessment Instruments. The response rate was 25%. Multivariate modeling was used to identify correlates of student knowledge, self-efficacy and attitudes.
Results: Sixty-nine sophomore (22%), junior (52%), and senior (26%) nursing students completed the survey. The sample was 87% white, 98% female and 71% had cared for a dying person, either in clinical or personal life. On average, students scored 5.8 (out of 7) on knowledge, scored 35 (out of 48) on self-efficacy and held positive attitudes towards EOL care. Class year was the only correlate of knowledge, while student's attitudes and class year impacted their self-efficacy. Students' attitudes towards EOL care were correlated with ethnicity, previous experience with EOL care, age and self-efficacy.

Conclusions: Enhancing student exposure to EOL care in the clinical environment positively impacts their attitudes towards caring for the dying patient. Nursing schools should consider actively incorporating hospice and palliative care experiences into their clinical rotations.

E-67: You don't know unless you ask: school nurses' role in identifying homelessness
Authors: Annabel Anderson and Margaret Coleman
Advisor: Dr. Elizabeth Dowdell

Purpose: Homelessness in childhood is a rapidly growing problem in the United States affecting children's health, education, and overall wellbeing. As a result, a law named the McKinney-Vento Act was enacted to protect and aid children experiencing homelessness. By appointing a local homeless education liaison in each school district, the act ensures that school children who are experiencing homelessness are identified and given resources to support their wellbeing. A piece of the identification process is the inclusion and training of all school personnel. Despite the designation of nurses as important personnel, there is little information as to what the exact role of a nurse is on this team. Furthermore, for school nurses, there is a lack of standardization when it comes to screening tools, assessments, and referral to resources. The purpose of our poster is to educate others about the McKinney-Vento Act and the role that school nurses can have in identifying children experiencing homelessness.

Method: An analysis of the current literature on homelessness and school nursing is offered along with suggestions for further research and implications for nursing practice. The articles incorporated were found through CINAHL and PubMed using the keywords identify, screen, assess, school nurse, homeless, children or youth or student, and McKinney-Vento Act. Legislation information was also found on school district websites and other government websites.

Implications: The lack of standardized identification protocol is a significant problem as evidenced by the link between homelessness and long-term negative health outcomes. Participation of school nurses on identification teams in addition to developing standardized assessment tools to promote positive child outcomes can inform nursing practice. It is important that school nurses, researchers, and nursing students understand that homelessness is a priority health issue. Given the therapeutic relationship that exists between school nurses and children, nurses are in a prime position to identify homelessness, seek education for themselves, and intervene early to improve health outcomes.

E-68: Fuel for life: a literature review of nutrition education and assessment among older adults living at home
Authors: Carolyn Astrup and Dr. Melissa O'Connor
Advisor: Dr. Melissa O'Connor

Nutrition is often considered the foundation of health and an important indicator of well-being. Older adults living at home are at particularly high risk for poor nutrition due to the likelihood of living with chronic diseases such as diabetes, arthritis, heart failure and cognitive impairment, as well as the financial instability and social isolation that often plagues this population. Older adults living at home who receive skilled home health may still be at risk for poor nutrition as the Outcomes Assessment Information Set (OASIS), the Centers for Medicare and Medicaid mandated home health assessment, does not contain items specifically related to nutrition assessment, leaving this important aspect of health potentially neglected. In the popular and empirical literature there is an abundance of information on what constitutes adequate nutrition for older adults. However, it is unclear how nutritional recommendations are provided to older adults or if nutrition status is routinely included in the home health comprehensive assessment. To address this gap, we conducted a state of the science related to nutritional assessment and education for older adults living at home. The PubMed, CINAHL, and MedLine databases were searched for relevant English language studies published

between 1998 and 2016 using the search terms "nutrition", "older adults", "assessment", and "education" with the two additional terms, "community" and "home health", generating eight studies eligible for inclusion. Five studies identified barriers to adequate nutrition and three tested interventions. Results indicate that nurses are the professionals believed to provide nutritional education and assessment most often in the home; however other professionals also play a role. Both health professionals and family caregivers reported feeling underprepared to assess, educate and meet the dietary needs of older adults living at home. Additional barriers included a limited time in the home and inadequate teaching materials. Interventions such as individualized dietician counseling and the development and testing of a malnutrition screening tool have been implemented to identify and mitigate risk for poor nutrition. Overall, an opportunity exists for significant improvement in the education and assessment of nutritional needs among older adults living in at home. Additional interprofessional research and education for health care professionals are critical to improving this population's nutrition status.

Philosophy

E-69: Eulogizing the Present: The Narrative Work of Contemporary Nostalgia
Author: Eric Aldieri
Advisor: Dr. Eugene McCarraher

This cultural study analyzes the reemergence of older cultural mediums—film cameras, VHS, cassette tapes, and 90s fashion—to complicate the discourses surrounding contemporary temporal experience and postmodern consumer nostalgia. Drawing heavily from the work of Walter Benjamin (particularly his figure of the collector) as well as Lauren Berlant and Gilles Deleuze, I argue that nostalgic affects, as they are manifested in strains of contemporary youth culture, are less about yearning for a romanticized past, and more aptly indicate an extreme discontent with the present. I argue that under conditions of precarity and damaged life, the present must be immediately relegated to a distant past in order to be assimilated into a life and a narrative. Nostalgic affects and dissociative positionalities this serve as guiding tools and strategies of self-narration, as the phenomenon of seeing and hearing oneself through a dead cultural medium constitutes a eulogizing of the present for the sake of marginal redemption.

E-70: Civilian-Military Relations, Human Rights and Military Professionalism in the Americas
Author: Emily Tenuta
Advisor: Dr. Patrick Paterson

This summer I conducted research with the William J Perry Center for Hemispheric Defense Studies, a U.S. Department of Defense (DOD) institution for defense and security studies in the Western Hemisphere. Through courses, seminars, outreach, strategic dialogue, and focused research in support of policy objectives, the Perry Center works with senior civilian and military officials from the Americas to build strong, sustainable networks of security and defense leaders and institutions. In so doing, the Perry Center promotes greater understanding of U.S. policy, mutually supportive approaches to security challenges, and improved institutional capacity. My work as a research assistant for the Center involved three different areas of focus: human rights, civilian-military relations and military professionalism, all of which contributed to the development of course-work, Perry Center publications, and the short-term and long-term projects of my advisers, Professor Patrick Paterson

and Ambassador Adam Blackwell. I collaborated with Professor Paterson on military power and the history of the M-19 terrorist group in Colombia, International Criminal Court cases, Special Tribunals, and narcissism among high-ranking military officials as well as conducted in-depth research on the use of International Humanitarian law in response to non-conventional armed conflicts. I also worked with former Diplomat in Residence, Ambassador Blackwell, on U.S. Foreign engagement strategy and appropriations in Central America. Until recently, more than 50% of the nations in the region were governed by national military powers. Though not the primary focus in U.S. Defense, Latin America is a climactic region to study and promote the development of human rights, combat of transnational organized crime and democratic governance. In addition to informing personal and career interests in the field of national security policy and Latin American politics, these particular areas of research are crucial to deepening the DOD's understanding of security and defense in Central and South America and U.S. foreign policy within the region.

Physics

E-71: Geometrically frustrated double perovskite synthesis and structural characterization
Authors: William Martin, Demitrios Papakostas, Jefferson Toro, and Dr. Jeremy Carlo
Advisor: Dr. Jeremy Carlo

Geometric frustration occurs in a material when magnetic order is inhibited by the way the magnetic ions in the compound are arranged. Commonly associated with triangular or tetrahedral coordination of moments favoring antiparallel alignment, frustrated materials can exhibit a variety of magnetic ground states because of the cancellation of normally dominant interactions. Geometrically frustrated materials are of interest for elucidating how magnetism arises in materials. Double perovskites of composition A2BB'O6, with 'rock-salt' order of magnetic B' ions, potentially exhibit frustration, with chemical versatility enabling the synthesis of many different compounds with divergent magnetic properties, making it interesting to see what combination of elements can yield new insights into frustration physics.

We report several compounds synthesized via solid state methods based on the Mo5+ ion, with particular interest in Sr2YMoO6, Ba2YbMoO6, and Ba2LuMoO6. These compounds, as well as several others, were predicted to have relatively stable lattices following their calculated Goldschmidt Tolerance Factors. We report the results of the structural characterization by the use of x-ray diffraction and further analysis through Rietveld refinement. We found that Ba2YbMoO6 and Ba2LuMoO6 crystallize in a simple cubic perovskite structure whereas Sr2YMoO6 exhibits a monoclinic structure. Syntheses of Sr2GaMoO6, Ca2AlMoO6, Sr2ScMoO6, Ba2InMoO6, Sr2AlMoO6, Ba2ScMoO6, Ba2GaMoO6, and Ba2AlMoO6 were attempted by the use of similar solid state methods. However, structural studies revealed that the desired phases were not produced. Possible causes for these discrepancies can include unreacted precursors, volatility of precursors, or formation of a non-perovskite structure.

E-72: Mössbauer analysis for the iron core structure of various artificially produced ferritins
Authors: Steve Kim and Arthur Viescas
Advisor: Dr. Georgia Papaefthymiou

Ferritin is a protein responsible for the storage of iron in living organisms. Ferritin is composed of a protein shell and an iron biomineral core consisting of ferrihydrite. Mössbauer spectroscopy can be used to find the oxidation state and coordination symmetry of the iron ion and overall electronic and

magnetic properties of the core. Using this spectroscopic technique we have tested the core-shell model of ferritin, which states that the biomineral core is composed of a magnetically ordered inner core and an outer magnetically disordered shell. In addition, the ferritin core is superparamagnetic, which means that the magnetic moments of the iron atoms are constantly flipping in direction. Our study probes the structure and superparamagnetic properties of the core and their dependence on the nature of the protein shell. Our results further validate the core-shell model of the ferritin core.

E-73: Cryogenic calibration sources for millimeter-wave astronomical instruments
Authors: Riley McCarten, Leah Berman, Vincent Mutolo, and Dr. David Chuss
Advisor: Dr. David Chuss

Measurement of the polarization of the Cosmic Microwave Background, the relic radiation from the early universe, provides an opportunity to study the universe as it was at an age of a fraction of a second. To do this requires high-precision cryogenic instrumentation. As part of this effort we present the development of low-reflectivity thermal sources for operation at millimeter wavelengths. Such sources can provide precise calibration. These calibrators are constructed of a carbon-loaded epoxy that is molded into a regular pyramidal pattern. Both the material and the shape are important in realizing broadband, highly absorptive structures.

Psychology

E-74: Parenting stress and developmental delays among infants and toddlers experiencing homelessness
Authors: Morgan Reid, Emily Jacobs, J. J. Cutuli, and Dr. Janette E. Herbers
Advisor: Dr. Janette E. Herbers

Out of 314,877 children who experienced family homelessness in 2014, over 50%were under age 6 years (Solari et al., 2015). Despite their prevalence, little is known about the developmental well-being of infants and toddlers who stay in family homeless shelters. Studies of older children have shown that homelessness presents risks for problems physically, mentally, and emotionally (Bassuk, Richard, & Tsertsvadze, 2015; Haskett, Armstrong, & Tisdale, 2015). However, studies have also shown that many children who experience homelessness show resilience, functioning well despite the risks (Masten et al., 2009). In order to design programs and policies to help infants and toddlers who are homeless, it is necessary to understand the factors that threaten or support their healthy development.

The sample consisted of 52 children between the ages of 0-33 months and their mothers recruited from family homeless shelters in Philadelphia. Female children represented 44.2%. Children were 65.4% African American with smaller numbers identified as White, Hispanic/Latino, or other. The children's well-being was assessed with the Brigance Early Childhood Screen III (Brigance, 2013), a standardized instrument recommended for use with diverse populations of young children, including children experiencing homelessness. It involves behavioral tasks and caregiver questions to assess motor development, language and communication, social-emotional well-being, and pre-academic skills. Scores are standardized so that each child's performance can be compared to population norms, identifying likely delays.

Parents also completed measures via interview. The Lifetime Events Questionnaire lists 20 negative lifetime events, and parents indicated whether they had ever experienced each event such as being the victim of violence, witnessing violence in their families or communities, or deaths in the family (Masten et al., 1993). The total number of unique events endorsed were summed for total

adversity scores. The Parenting Stress Index, Short Form (PSI-4-SF: Abidin, 1995) is an inventory of 36 statements describing differences in current stress related to the parenting role. Parents respond using five-point Likert scales, and all items are summed for a total stress score.

Out of the three domains, infants had the lowest percent that scored below average in the overall Brigance with 11.1%. The same percentage also scored below average for both physical and language development followed by adaptive at 3.7%. Overall, 26.7% of toddlers scored below average, 6.7% below average in physical development, 73.3% in language development, and 26.7% in adaptive. Two-year olds had the highest percentage in every category with 70% scoring below average overall, 50.0% in physical development, 90.0% in language development, and 80.0% scored below average in academic/cognitive development.

A linear regression predicting Brigance overall scores with predictors of adversity, parenting stress, and child age showed that parenting stress ($\beta = -.351$; $p = .002$) and age ($\beta = -.529$; $p < .001$) significantly predicted Brigance scores. The risk of developmental delays increases with the age of the child, particularly in the domain of language, and well-being of children is associated with the level of stress parents experience. Findings will be discussed in relation to developmental science and implications for policy and service provision for families experiencing homelessness.

E-75: Parental engagement: attributions of responsibility and stigma

Author: Carlin Welter
Advisor: Dr. Charles Folk

Previous research has suggested that there is a large discrepancy in mental health service use between white and minority children. However, little research has focused on the pathways and attributions of responsibility that influence parents' decision to seek help for their children. We were interested in examining the role that race/ethnicity and demographic factors, such as education level, play in stigma against children with mental health disorders and attributions of responsibility surrounding children's mental health disorders. This study utilized a semi-structured questionnaire comprised of several strong psychometric measures and three different case vignettes to interview 35 parents/caregivers of children with serious mental health disorders within the Tampa area. This study analyzed participants' levels of persona Ericksonl stigma, attributions of responsibility of causation, and attributions of responsibility for solving or improving problems as moderated by both race/ethnicity and vignette context. This research could significantly lessen the gap between white and minority mental health service use by laying the groundwork for a better understanding of race/ethnicity and its effect on parent/caregivers' stigma and attributions.

E-76: Eating disorders in the workplace

Author: Jaclyn Siegel and Dr. Katina Sawyer
Advisor: Dr. Katina Sawyer

As of 1996, eating disorders (EDs) were the third most common chronic illness among females in the United States, and they have become more prevalent in recent years (Goldman, 1996). The DSM-V recognizes three distinct categories of eating disorders in adult populations: Anorexia Nervsoa (AN), Bulimia Nervosa (BN), and Binge Eating Disorder (BED). EDs are largely considered to be chronic and often require consistent maintenance (Fairburn, Cooper, & Cooper, 1986). Those with EDs often experience stigma, which can be defined as "any persistent quality of an individual or group that evokes negative or punitive responses from others" (Westerholm et al., 2006: 1503), often resulting in disqualification from full social acceptance (Goffman, 1963). Many psychological diseases can be

classified as invisible illnesses, but due to the behavioral symptomatology of EDs, the disease also has visible characteristics. Most psychological diseases, such as eating disorders, classify as disabilities. As such, individuals with ED are legally protected against workplace discrimination and must be provided with reasonable accommodations (Americans With Disabilities Act, 1990). Although many individuals with psychological disorders wish to participate in the workforce, stress exacerbates symptomatology of all psychological illnesses (Abramowitz, Deacon, & Whiteside, 2012). Thus, given the demands of working life, the workplace may serve as an intensely stressful environment for individuals with eating disorders. Despite the possibility for the workplace to cause stress for individuals with EDs, the literature has been largely silent on this issue. Thus, the current work aimed to answer one primary research question: How do individuals with eating disorders manage their disease in the workplace?

Study Methods and Results: In this study, we investigated the ways in which eating disorders interact and interfere with work, in areas such as productivity, job satisfaction, and social involvement. 50 participants (48 women, 2 men) were recruited through social media, and each individual self-identified as having an eating disorder (48% AN, 10% BED, 18% BN, 24% combined). Participants engaged in an hour-long semi-structured telephone interview in which they described workplace triggers experienced and symptom management strategies utilized at work along with the effectiveness and consequences of these techniques. 30% of participants identified as being "in a state of recovery", 28% considered themselves to be "partially recovered" or "actively trying to recover", and 42% noted that they were "not recovered". Data were analyzed using rigorous qualitative analysis methodology, stemming from the recommendations of Corbin & Strauss (2008). Themes emerging from this qualitative analysis are reported below.

Overall, workplace triggers surrounding eating disorders were consistent for all participants. The most common workplace trigger was unhealthy workplace culture, including constant diet talk and weight loss competitions between coworkers. The abundance of food and food-related events in the workplace also proved difficult for those with EDs.

Management techniques and outcomes varied dramatically across disease and state of recovery. Individuals still struggling with AN were heavily impacted by their disease at work, often reporting inability to concentrate, passing out, and difficulty engaging in social life for fear of being confronted with social eating situations. Inability to interact with coworkers and reduced productivity led to limited networking opportunities and difficulty keeping jobs. Those battling BED and BN appeared to be better able to engage in social situations, yet experienced shame or engaged in compensatory behaviors immediately after. Individuals with AN were more likely to disclose their EDs than those with BN or BED, and disclosure proved to be a beneficial identify management strategy. The most popular reason for disclosure was requesting accommodations for treatment purposes. Those with EDs often overestimated the amount of stigma they would experience following disclosure. Fear of stigma was highest in educators and mental health professionals. Interestingly, within this population, the stigma that was much more pernicious to workplace life, compared to stigma stemming from others' perceptions, was self-stigma - those with ED were likely to hold themselves back from pursuing higher opportunities in the workplace for fear of they would not be able to manage their symptoms in a more stressful position. Though many worried that requesting accommodations would inconvenience the workplace, those that accepted them often reported improvements in performance and job satisfaction.

An unexpected finding from the study was that only 2 of the 15 individuals that considered themselves completely recovered from their eating disorder had exclusively sought outpatient treatment while working for symptom management. The remaining 13 had either taken FMLA or worked from home in order to avoid workplace triggers during treatment. It appears as though engaging in the workplace while seeking intensive treatment is an ineffective symptom management technique as those that attempted to recover while at work (58% of participants) had generally low

levels of recovery (51.7% nonrecovery, 27.6% partial recovery, 20.7% complete recovery) and often used elements of the workday to engage in disordered eating behaviors.
General Discussion: This study has important implications for men and women struggling with eating disorders in the workplace. Primarily, although engaging in work is often a financial necessity and social desire for those with ED, the stress of the tasks and often-unhealthy emphasis on food in workplace culture often exacerbated ED symptoms, making relapse likely, maintenance difficult, and recovery nearly impossible. Our results suggest that those who find themselves beginning to relapse should seriously consider requesting accommodations such as altered work hours or time off in order to learn how to better manage their symptoms. Also, disclosure appears to be a necessary prerequisite for social involvement in the workplace for those in a period of relapse or partial recovery. Thus, workplaces would be well-served to educate employees on available benefits for those with EDs and to create work environments in which employees managing stigmatized identities feel they can be authentic. Further, the existence of even a single ally appears to dramatically decrease stress at work. Thus, educating and empowering employees to support those with EDs at work, as well as an increased awareness of potential triggers for those managing EDs, may help to create a more supportive and healthy work environment overall.

E-77: The combined effect of alcohol and serotonin deficiency on neurogenesis
Author: Austin Wild
Advisor: Dr. Ben Sachs

New neurons are continuously generated throughout adulthood through the process of neurogenesis. Neurogenesis is a multistep process that consists of proliferation of neural stem cells, differentiation and survival of these cells and the integration of new neurons into brain circuitry. Dysfunctional neurogenesis has been hypothesized to play a role in many different neurological and psychiatric disorders such as alcohol use disorders (AUDs), post-traumatic stress disorder and major depression. However, the effects of chronic alcohol consumption and serotonin (5-HT) levels on hippocampal neurogenesis are controversial and have not been conclusively established. Using immunohistochemistry and confocal microscopy with the cell proliferation marker, bromodeoxyuridine and the neural precursor cell marker, nestin, we have examined the effects of chronic alcohol and brain 5-HT deficiency on neurogenesis in the hippocampus, sub-ventricular zones, and hypothalamus. While data collection is complete, the data is still being analyzed. Once quantification is complete, we will be able to test our hypothesis that brain 5-HT deficiency and chronic alcohol consumption inhibit adult neurogenesis. The results of this study may have important implications for our understanding of the etiology of AUDs and mental illness, and may provide a mechanism whereby chronic alcohol and low brain 5-HT can impact neural function and behaviors.

Special appreciation to the following sponsors:

Office of the Provost

Center for Undergraduate Research and Fellowships

College of Engineering

College of Liberal Arts and Sciences