Abstracts: Oral Presentations

All oral presentations will take place in the Devon Room at the times listed below

Computing Sciences

(2:00 p.m.)

Financial Modeling and Forecasting using Deep Learning
Author: Dineen, Shay
Advisor: Dr. Benjamin Mitchell

Accurate stock market modeling and forecasting has eluded analysts, hedge funds, brokerages, and investors since the first stock exchange was created in 1773. Billions of dollars and tens of thousands of man hours have been invested in the pursuit of developing an accurate and robust stock market predictor. Even with this high level of interest, firms have had only limited success in modeling financial time series data. The task of modeling the stock market is considered to be so difficult, that many in the financial industry have written off this problem as insolvable. Statistical and machine learning based approaches have lead the way in stock market modeling since the early 1980s, however even their success has been limited do to the highly complex nature of financial markets. Noise and random price movements have hindered the performance of these models as they either tend to under fit (fail to make accurate predictions) or over fit (fail to generalize to new data). The rapidly growing field of deep learning has the ability to minimize these issues while also being able to make predictions with generally low error. Recent developments in the growing field of deep learning has propelled this technology into the forefront of technological innovation. Self-driving cars, personal AI, drug discovery, and even Elon Musk's SpaceX all heavily rely on deep learning applications. Financial forecasting and modeling using deep learning has remained a largely unexplored field. This research aims to tackle financial modeling and forecasting using a widely practiced variation of Recurrent Neural Networks (RNNs) called a LSTM. LSTMs are a widely used network configuration that excels in sequence modeling. On an intuitive level, LSTMs aim to find patterns within time series data to be able to make a prediction. In addition to using a LSTM, this research also explores the possible benefits and drawbacks of using a stacked autoencoder (SAE) to 'massage' the data before it is fed into the LSTM. Data messaging and preprocessing are important steps in creating any type of machine learning model as the format in which the data is entered in can greatly impact the performance of a given model.

Economics

(2:15 p.m.)

What is the Impact of Monetary Policy on Wealth Inequality?
Author: Fagerstrom, Matthew
Advisor: Dr. Michael Curran

Given both the unconventional monetary policies of the Great Recession and the growing attention paid to inequality in political discourse, investigating the impact of monetary policy on wealth inequality is warranted. We construct a data set covering 143 countries across 6 time periods to investigate the relationship between monetary policy and wealth inequality. Results from dynamic panel data estimation suggest that both total and inherited wealth inequality increase with growth in the base money supply. Interest rates do not have a significant distributional impact when controlling for the business cycle. These results hold for a subsample of OECD countries.

History

(2:30 p.m.)

Elizabeth Powel: An Example Of Women in Finance from 1776 - 1835
Author: Keaveny, Erin
Advisor: Dr. Whitney Martinko

This project combines a deep analysis of Elizabeth Powel's personal and financial records, and new analysis of the U.S. Government Bond Trading Database from Pennsylvania between 1776 and 1835 to develop a fuller understanding of women in finance and investment in the early American Republic. Elizabeth Powel served as the matriarch of the Powel Family after her prominent husband's death in 1796 until 1830. Upon her husband's death, she took over the family's vast financial and real estate holdings and managed them for there remainder of her life, at which point the majority of the Powel estate was left to her nephew. Through a close reading of Powel's correspondences and finances it becomes clear that she had a thorough understanding of emerging capitalist markets, and acted autonomously in her investments. Focusing on Powel's investments in stock and real estate, and the correspondence that went along with them, provides insight into the life of one of Philadelphia's wealthiest people at the time. Yet, it is only after contextualizing that study with the database that Powel can be seen as one of many female investors from different social classes, occupations, and races. Her papers also provide an example of the ways that women employed historically gendered language in financial matters. While the historical conversation has largely neglected women's participation in financial markets, some previous work has argued that women only made investments under the close advisory of men, or out of necessity for maintaining her family as a widow, this study suggests otherwise. Elizabeth Powel should not be studied as an exceptional case, but instead as a missing link in scholarship between an understanding of women's economic dependence on their husbands, and a more nuanced and modern understanding of women's opportunity for financial autonomy in the early American Republic.

(2:45 p.m.)

History and Memory in Philadelphia's Black Graveyards, 1792-1854
Author: Marshall, Jubilee
Advisor: Dr. Whitney Martinko

In 1810, Mother Bethel Church, the first African Methodist Episcopal Church in the United States, acquired a plot of land to be used as a burying ground for their black parishioners. It was in use for fifty years before it eventually filled to capacity and was sold back to the city of Philadelphia. The burying ground was then forgotten for over a century, until it was rediscovered during renovations of Weccacoe community playground in 2013. Bethel Burying Ground was just one of a number of black burial sites in Philadelphia that existed during the first half of the 1800s; however, these spaces have been overlooked in traditional histories of the city. My research contextualizes these burial grounds, understanding them both as physical funerary sites and as religious and cultural institutions within the free black community. Using archaeological surveys, death registrations, newspapers, and church records, I have examined the city potter's field, black and white churchyards and religiously-affiliated burial grounds, and private, non-denominational cemeteries. This research reveals the extent to which white hostility, institutional racism, and black independence shaped the landscape of burial practices in Philadelphia in the early United States. Future research will focus on strategies of memorialization that work with and respond to the needs of the communities in which these burial grounds are situated.

Augustine & Culture Seminar Program (ACSP)

(3:00 p.m.)

The Progression of Gothic Philosophy Across Mediums
Author: Gold, Zbynek
Advisor: Dr. Betty Patch

This research examines the adaptive nature of Gothic philosophy across mediums; in particular, how H.P. Lovecraft's philosophy influences modern day video games. Beginning with a history of the Gothic and its philosophy, this paper outlines the Gothic's emotional progression from terror to horror. This progression through literature culminated in the work of H.P. Lovecraft which makes extensive use of horror to convey its philosophy. Video game developers later resumed this progression and now incorporate the same emotions and philosophies in their games. This paper defines the criteria for a Gothic video game genre and explores in depth the influence of H.P. Lovecraft on the form and content of a few specific examples. This research demonstrates the validity of certain video game narratives and reveals the pervasive nature of Gothic philosophy and its progression across mediums.

Institute for Global Interdisciplinary Studies

(3:15 p.m.)

Beyond the State: Rojava and Revolution
Author: Flynn, Patrick
Advisor: Dr. Maghan Keita

Writing for The Independent in late 2015, renowned journalist Patrick Cockburn condemned the global community for allowing Syria to slip into a state of what he called "anarchy." He ends his article with a sweeping historical claim: "The decline of nationalism and the nation state has been replaced by nothing better and has opened the door to monstrous but fanatical movements such as ISIS." ""Beyond the State: Rojava and Revolution"" seeks to challenge Cockburn's characterization, and the prevailing wisdom upon which it relies. The project consists of: 1) a literature review covering relevant social science literature and anarchist/ Neo-Marxist thought, 2) a historical and political analysis of the Kurds and the Syrian government, 3) a consideration of future prospects and challenges for the community, and 4) an analysis of U.S. media and foreign policy related to Rojava.

English

(3:30 p.m.)

A Teacher's Challenge: Alice Dunbar-Nelson and the Quest for Racial Equality

Author: Beaton, Gia
Advisor: Dr. Jean Lutes

The "Alice Dunbar-Nelson Recovery Project," a research team of three first-year students who worked under the guidance of Dr. Jean Lutes of the English Department, focused on the works of Alice Dunbar-Nelson, a black-female author who wrote during the late nineteenth and early twentieth centuries. My research helped Dr. Jean Lutes in the writing of her seminar paper titled "Recovering Childhood Desire: Alice Dunbar-Nelson and 'His Heart's Desire' (1900), a short story inspired by Dunbar-Nelson's experience teaching poor African-American children. This research included searching databases for information that pertained to a previously unknown short story of Dunbar Nelson's titled "His Heart's Desire" about a young boy who desired to have a doll. I compared two different versions of the story to see what changed between the manuscript version of the story and the published version. For my own research project, I studied Dunbar-Nelson's professional life as a teacher and her struggles with education in the classroom. As a graduate of Cornell University, Dunbar-Nelson was highly educated, especially compared to other black females in her era. She attempted to transfer this passion for learning and education to her students through the art of English, however she struggled with this endeavor which is apparent in her essay "The Compensation of a Teacher of English" as well as one of her letters titled "Friday Afternoon" which describes one of her meetings at a junior high school. Dunbar-Nelson's educational memorabilia and essays are ironic in the sense that Dunbar-Nelson struggled to ignite her passion for education in others. The

documents bring to light the trials and tribulations of teachers as well as the disparities in education for black children in America, both of which are still present today.

(3:45 p.m.)

An Investigation of the Writing Process and Style of Alice Dunbar-Nelson

Author: Solomon, Jacquelyn (presented by Gia Beaton)
Advisor: Dr. Jean Lutes

It is quite common for an author to write and re-write a piece with multiple revised drafts. Alice Dunbar-Nelson, an African American writer prolific during the early 1900s, was no exception. Dunbar-Nelson's short story "His Heart's Desire" has two distinct published versions in addition to its known manuscripts in the well-preserved archive collection at the University of Delaware. Our team--three undergraduates under the guidance of Dr. Jean Lutes -- contributed to the recovery and rediscovery of Alice Dunbar-Nelson's life and work through the contextualization of "His Heart's Desire." The process of discerning what the differences within the stories meant in order to illuminate Dunbar-Nelson's life and writing style included extensive internet and library research, reading collections of the author's works and microfilm of old newspapers, and the handling of original manuscripts. The Alice Dunbar-Nelson collection at the University of Delaware Archives was both enlightening and extensive. I formed my theory based on a brief examination of a few of the manuscripts. Upon initial glances at Dunbar-Nelson's hand-written manuscripts, the stories "Miss Tillman's Protégé" and the "Missing Copy" seemed to have similar phrases, names, and some ambiguity in terms of dates of publication. Over the summer I examined the language within the manuscripts of the two stories and their published copies in order to prove or disprove my belief that, not unlike the two variations of "His Heart's Desire," "Miss Tillman's Protégé" and the "Missing Copy" were related in that the latter evolved into the published version of the former. In the end, my project resulted in an intriguing new knowledge of handwriting in 1900, an appreciation for literary investigation, and insight into an understudied yet extraordinary female author whose writings are unique to her time.

Abstracts: Posters

Augustine & Culture Seminar Program (ACSP)

A-01: Giving Birth in Beauty: Educating Love in Plato and Augustine
Author: McGuire, Karen
Advisor: Dr. Ian Clausen

"Giving Birth in Beauty: Educating Love in Plato and Augustine" is centered around the idea that through loving, more specifically through loving wisdom, we are able to know ourselves in a way that reflects the way God knows us already. Both Plato and Augustine command their audiences to "Know Thyself" ("Gnothi Seauton" in Greek) and to become philosophers ("lovers of wisdom"). Through his famous parable "The Allegory of the Cave," Plato illustrates that education is less about imparting information, and more about reorienting the rational soul "until it is able to bear to look at what is and at the brightest thing that is—the one we call the good" (Republic, 518c). And through that shifting of our gaze, we discover a simple truth: we are lovers. Through loving, we are elevated and we are grounded as we travel deeper into ourselves, seeking to know ourselves as God knows us. As we start to discover who we are, we are stretched by God and filled by the Holy Spirit. The Holy Spirit is our source of charity, and in the desert of earthly life, Augustine calls us to drink charity. Charity promises completion, unification, and immortality, in the way that we are indwelt by the unchanging God forever.

Astronomy & Astrophysics

A-02: Sun In Time: The Evolution of the Atmospheres of Solar Type Stars
Author: Dalton, Briana; Guinan, Edward; Engle, Scott
Advisor: Dr. Edward Guinan

Though it may not be apparent, the Sun in our solar system is undergoing drastic changes as time progresses. Most notably, from the Age Rotation Relationship (E. Guinan and S. Engle), the period of rotation for the Sun has slowed and will continue to slow as the magnetic activity decreases. To model the activity of how our Sun is evolving, as well as how a range of solar type stars are evolving, stellar characteristics such as spectroscopy, age, period of rotation, distance, x-ray fluxes, and line fluxes must be studied and analyzed. The spectral classification of these solar type stars ranges from G0 V to G5 V, creating a more complete picture of solar activity overall. In this study, we update the Sun in Time investigation by analyzing the stellar properties of the Sun and several G-type stars, such as HD 209458, Alpha Centauri A, and 51 Pegasi. From this analysis, we report how they are evolving, as well as how the Sun continues to evolve. Amongst these stars, we characterize the Age-Rotation relation, the Lyman Alpha Magnesium relation, the Age X-Ray Luminosity relation, and the Rotation X-Ray Luminosity relation. We find these characteristics to be intrinsically related to each other. Therefore, we present inferences about how such solar type stars, and the Sun, will behave as well as the state of their atmospheres.

A-03: Designing a Python Module for the Calculation of Molecular Parameters and Production Rates in Comets

Author: Guzman, Giannina; De Val-Borro, Miguel
Advisor: Dr. Miguel De Val-Borro

Comets provide an inside look to the solar system's physical and chemical processes during the epoch of planet formation, and are one of the leading possible sources of water and organic materials to primitive planetary surfaces. One of the most important values in comet studies is the production rate of observed molecules in the comet's coma. This value gives us insight to molecular abundances (composition) for estimating relative abundances in the nucleus, providing information on periodicity of the comet, and significant comparisons in composition from comet to comet. These insights give us key information about the chemical conditions of our early solar system, and to the possibility of comets as a source of water and organics on Earth. Presently there are various models that can be followed to calculate the production rate in observed spectra of comets, yet these models and their algorithms are calculated by researchers on an observation-by-observation basis due to the lack of availability of a generalized toolbox for the analysis of observations. The upcoming influx of data stemming from the growing interest in comet studies and the development of new technology will, then, prove to be a challenge for researchers to keep up with. As a solution to this problem, there is a community-effort-based and NASA funded project to build sbpy, an astropy affiliated Python package for small body research. To further the development of sbpy, I have worked on various functionalities for the package. The first of these functionalities was an Astroquery module to allow the query of JPL's Molecular Spectroscopy catalog. This proves to be a key functionality required for sbpy's spectroscopy module, providing the values needed for the calculation of necessary molecular constants. This module is a part of Astroquery's new version, soon to be released. The second functionality I have worked on is part of sbpy's spectroscopy module and it involves the calculation of molecular production rates following two very specific models. This functionality was written with millimeter/sub-millimeter wavelength bands as the primary input, but is adaptable to other wavelengths. The first model I worked to recreate was a simplification of the local thermal equilibrium (LTE) Haser model, which does not include photodissociation, as described in an existing publication (Drahus 2009). This functionality has already been compared to results calculated in the peer-reviewed literature (Drahus 2012) and have shown a 0.4% error at most. The error is suspected to stem from the difference in computations of molecular parameters. Drahus may have used the CDMS catalog for some of these parameters, while we calculated them from theoretical formulas. I also worked to recreate the LTE Haser model including photodissociation rates at the comet's distance from the Sun. This model calculates the number of molecules observed for an arbitrary production rate and also calculates the number of molecules observed from the input data. The production rate is then computed through the ratio of these results. The comparison between this model and existing data (Wierzchos et al., 2018) has yielded a 2.5% error or less.

A-04: Big Data, Astronomy, and Virtual Reality — An Unprecedented Look at Kepler/K2 Data

Author: Mutolo, Vincent; Prsa, Andrej
Advisor: Dr. Andrej Prsa

There exist data sets, commonly known as Kepler and K2, which contain remarkably precise and extensive observations of our galaxy. These data sets contain light curves from myriad sources, including many types of solar systems. The light curves were extracted and run through dimensionality

reduction algorithms to display the meaningful aspects of the data in a human-readable way. Human-readable, in this case, means a plot of the relationships between the light curves. We chose to use a virtual reality headset in conjunction with 3D modeling software to display the relationships between the data. In choosing the best reduction algorithm to find these relationships, multidimensional scaling (MDS) and Principle-component analysis (PCA) were both tried. However, they were unsuccessful in recognizing patterns in the data. It is likely that their failure is due to the highly nonlinear nature of the relationships in question. Specifically, a normalized Fourier-transform was first applied to each light curve, and then the reduction algorithms were applied. T-distributed stochastic neighbor embedding (t-SNE) is a relatively new dimensionality reduction algorithm, which was applied successfully to the data. It is known for its success with finding patterns in highly-nonlinear systems. Of particular interest is that several points in the data were identified as outliers, which was the primary goal of this work. Future work may now be more concentrated on those stars (or systems) which are abnormal, and therefore present a higher chance of leading to new and unexplained phenomena.

A-05: Using dK/M Star Age-Rotation-Activity Relationships to Gauge Planetary Habitability
Author: Purcell, Kasey; Engle, Scott
Advisor: Dr. Scott Engle

Red Dwarf stars (dwarf K and M stars, or dK/M stars) make up over 90% of the local stellar population. This is among the reasons they are being targeted by numerous planet-hunting programs. An increasing number of exoplanets continue to be discovered orbiting dK/M stars which makes it critically important to devise an accurate method for determining the ages of field dK/M stars. However, due to their long lifetimes, and very slow nuclear evolution, the best method for determining ages would seem to be through an age-dependent observable quantity, such as stellar rotation rates. Over the past several years we have furnished relationships between stellar rotation rate and age for dK/M stars. To assess the habitability of planets hosted by these stars, we also need to delineate the X-UV (X-ray to ultraviolet) radiation environments these planets are currently exposed to, and have been exposed to in the past. In this study, we have utilized UV observations of dK/M stars carried out with the International Ultraviolet Explorer (IUE) satellite and the Hubble Space Telescope (HST), in combination with stellar ages, to build up reliable Age-Rotation-Activity relationships for dK/M stars and determining the X-UV environments that exoplanets around these stars will be subjected to. We gratefully acknowledge support for this project from Villanova CRF, NASA, and the National Science Foundation.

A-06: A New Method to Improve Radial Velocity Coverage in the USNO Bright Star List in the Astronomical Almanac
Author: Rura, Christopher; Stewart, Susan G.
Advisor: Dr. Edward Fitzpatrick

The USNO list of bright stars gives designations, positions, magnitudes, spectral types, radial velocities, and other important astrometric parameters for roughly 1500 visually bright stars in a roughly even spread around the sky. Radial velocities of bright stars are important parameters to assist in determining positions of bright stars in the sky for navigational purposes. It was brought to my attention that the current USNO bright star list only has radial velocity measurements for about 22% of the stars in the catalog. Given that many navigators and astronomers rely on this list for accurate astrometric parameters of bright stars, this raised a concern. This research project gives a possible consideration for vastly improving the coverage of radial velocity measurements in the catalog, using

data from the GAIA DR2, released in April 2018, as well as other catalogs with acceptable radial velocity measurements. This research also reviews a program that was developed in order to develop this method and gives suggestions on the use of the program in the future to provide the optimal results of star positions in future versions of the bright star list.

Biochemistry

A-07: Characterizing Poly(ADP-ribosyl)ation in Brain Tumors
Author: Coleman, Ashley; Hermanowski, Henre; Jaworski, Diane; Quénet, Delphine
Advisor: Dr. Delphine Quénet (University of Vermont College of Medicine)

Poly(ADP-ribosyl)ation (PARylation) is a post-translational modification, in which the polymer of ADP-ribose (PAR) is attached to target proteins (e.g. histones and chromatin-binding proteins) as a linear or branched chain. Two fundamental proteins in the regulation of PARylation are PAR polymerase-1 (PARP-1) and PAR glycohydrolase (PARG), which synthesize and degrade PAR, respectively. Previous work has shown PARylation to be a cellular signal for the maintenance of genome integrity, by modulating DNA repair, transcription, replication and cell death. The significance of PARylation to cell viability has led to clinical interest in the manipulation of PAR metabolism as an anti-cancer therapy. Hence, several PARP inhibitors have been FDA-approved for the treatment of BRCA-mutated ovarian cancer and their therapeutic interest, in other cancers, is currently being tested in clinical trial. Substantial data on the potential efficacy of PARylation manipulation, in brain cancer specifically, is lacking. The aim of this project is to characterize PARylation in brain tumors by analyzing the expression and localization of PARylation factors, PAR, PARP-1, and PARG. A western blot, targeting the expression of PAR, PARP-1, and PARG, was performed on normal, benign, and malignant human brain tissue (n= 49). To match the expression of PAR, PARP-1 and PARG to specific cell types, immunohistochemistry was performed on normal brain and glioblastoma (GBM, WHO grade IV) tissue sections. While this project is ongoing, the work conducted this summer shows that there is a differential expression of PARP-1 and PARG, but not PAR between normal, benign, and malignant brain tissue. The findings of this project could provide insight into the potential of PARylation manipulation as a predictive and prognostic tool to treat and prolong survival in patients diagnosed with brain cancer.

A-08: Evaluating the ability of the combination treatment sulforaphane and dtBHQ to synergistically protect cells from oxidative stress
Author: Macpherson, Claudia; Repash, Elizabeth; Byrnes, Kayla; Eggler, Aimee
Advisor: Dr. Aimee Eggler

Sulforaphane, a naturally occurring molecule found in cruciferous vegetables, functions as an activator of the Nrf2 transcription factor. Activation of the Nrf2 pathway switches on cytoprotective genes, whose antioxidant, detoxification, and repair properties are proposed to diminish symptoms of various conditions, including cancer and neurodegenerative diseases. The small molecule 2,5-di-tert-butyl-1,4-hydroquinone (dtBHQ) is a non-electrophilic generator of reactive oxygen species (ROS), which also activates the Nrf2/ARE pathway and greatly increases the potency and efficacy of sulforaphane. Having observed this heightened ARE activation, our lab wanted to determine whether this response resulted in a cytoprotective effect against stressors, such as high oxidative stress from hydrogen peroxide. The lactate dehydrogenase (LDH) assay quantitatively measures the amount of LDH leaked into the media, which is correlated to cell death. My summer project was to establish this assay in our

lab in a 96-well format in order to quantify the cytoprotective benefits of sulforaphane and dtBHQ against oxidative stress.

A-09: The path from a marine sponge to synergistic activation of the ARE cytoprotective pathway in human keratinocytes
Author: Byrnes, Kayla
Advisor: Dr. Aimee Eggler

Many individuals are afflicted with life-altering chronic diseases such as rheumatoid arthritis, heart disease, and cancer. Activation of the Nrf2/ARE/Keap1 pathway in our cells has been shown to produce cytoprotective enzymes that mitigate these chronic disease conditions. This pathway has been shown to be activated by small molecules, including electrophiles and reactive oxygen species (ROS) generators. Four aminoquinones, originating from a marine sponge, show high activation of the Nrf2/ARE pathway. These inspired the generation of an analog with the hopes of achieving the high activation that the four derivates exhibited. After confirmation from mass spectrometry data that the addition could not be stereospecified, the precursor to the final synthetic step, the methoxyquinone (MOQ) analog, was tested for its Nrf2/ARE activation. MOQ showed little activation on its own, but when paired with the electrophile sulforaphane, MOQ elicited a potentially synergistic activation. Future work will be conducted to investigate the interaction between the electrophile sulforaphane and ROS-generating small molecule MOQ.

Biology

A-10: Characterization of a Putative Transcription Factor Binding Site in the THI20 promoter of Saccharomyces cerevisiae
Author: Barbour, Kristin; Wykoff, Dennis
Advisor: Dr. Dennis Wykoff

Thiamine pyrophosphate (TTP), or phosphorylated Thiamine (Vitamin B1), is an essential cofactor required for the metabolism of amino acids and carbohydrates. To synthesize TPP, Saccharomyces cerevisiae can utilize thiamine from its environment or produce thiamine de novo. Approximately 10 genes have been identified in the thiamine signal transduction (THI) pathway of S. cerevisiae. The genes within the THI pathway are regulated transcriptionally by the THI3, THI2, and PDC2 genes. The transcription factors, Thi2 and Pdc2, work with the Thi3 regulatory factor to induce, or upregulate, genes within the THI pathway during thiamine starvation. Previous characterization of the ScTHI20 promoter, which regulates THI20 (a gene required for de novo TPP synthesis) identified a potential Thi2 or Pdc2 binding site near -170 to -165bp upstream of the start codon ATG. Further investigation revealed that similar consensus sequences existed within the ScTHI4 promoter and ScTHI5 promoter. I investigated the significance of this site by using PCR and Gibson Assembly cloning to delete the putative site in the ScTHI20 promoter and insert it into a digested plasmid with a yellow fluorescent protein (YFP) gene. Using flow cytometry to measure YFP expression, I demonstrated that a deletion within this region in the promoter did not decrease ScTHI20p expression under thiamine starvation. This suggests that this site is not a binding site for either transcription factor or that multiple Thi2 or Pdc2 binding sites may exist within the promoter and the loss of one site is not enough to disrupt THI20 expression.

A-11: Investigation Brd2a and Brd2b Interaction During CNS Development
Author: Burda, Bella
Advisor: Dr. Angela DiBenedetto

Programmed cell death acts to rid multicellular organisms of aberrant cells while keeping normal cells intact. It is also important during development for sculpting tissues during morphogenesis. The Brd2 gene is conserved across a variety of organisms, and encodes a regulatory protein involved in central nervous system (CNS) formation and the control of cell death during development. Due to a genomic duplication event, zebrafish have two paralogous copies of this gene, which show partially overlapping expression patterns. Decreasing expression of Brd2 in mice, or decreasing expression of either Brd2 paralog in zebrafish, results in a reduced hindbrain and other CNS abnormalities, stemming mainly from an excess of neuronal cell death. Surprisingly, this lab recently discovered that decreasing the expression of both zebrafish paralogs simultaneously restores the morphology of the brain and the levels of cell death to normal. This implies a genetic antagonism, and possibly a molecular interaction, between the two paralogs. In this study, vectors for synthesis of in vitro mRNA were created, allowing for overexpression in zebrafish embryos of synthetic brd2a or brd2b transcripts that are impervious to knockdown by antisense morpholinos. Co-injection into embryos of mRNA from one paralog with antisense morpholino from the other paralog will test for mutual antagonism by looking for enhancement of the mutant phenotype. Understanding the interaction between zebrafish Brd2 paralogs may provide novel insight into the mechanisms of Brd2 action and its control of cell death in both fish and mammals. As human Brd2 is a known protooncogene in blood cancers and a susceptibility locus for juvenile myoclonic epilepsy, mechanistic insights may also provide novel drug targets for these diseases.

A-12: DAF-18 is required for DAF-16-mediated immunity in adult C. elegans
Author: Carrasco, Kali
Advisor: Dr. Matthew Youngman

In Caenorhabditis elegans the insulin/IGF-1(IIS) DAF-2 signaling pathway regulates stress-resistance and determines lifespan by controlling the activity of DAF-16, an evolutionarily conserved FOXO transcription factor. Our lab has shown that DAF-16 activity increases in an age-dependent manner, even in the absence of stress. Accordingly, DAF-16 plays a role in the innate immunity of adult but not larval stage worms; therefore, we are interested in understanding how DAF-16 becomes activated during adulthood. Since DAF-16 is prevented from translocating into the nucleus when insulin is bound to its receptor, our observations suggest that, as worms age, an inhibitory signal from the insulin pathway must be counteracted to allow for DAF-16 activity. We hypothesize that one or more factors which may antagonize this inhibitory signal lie upstream in the insulin signaling pathway. We used a RNAi-based reverse genetic approach to probe the role of individual members of the insulin signaling pathway in the regulation of DAF-16 in post-reproductive adult worms. Potential age-dependent regulators of DAF-16 were initially identified by assessing expression levels of an in vivo GFP reporter of DAF-16 transcriptional activity in RNAi-treated animals. Our data indicate that DAF-18 is required for the increase in expression of DAF-16 targets during adulthood, including those that play a role in host defense. Accordingly, we find that DAF-16-mediated immunity is compromised in both daf-18 RNAi knockdowns and daf-18(ok480) mutants, leading to a reduced capacity to resist bacterial infection exclusively in adult worms and not larvae. DAF-18 encodes a phospholipid phosphatase purported to dephosphorylate PIP3, thus reversing the first step in the insulin signaling pathway, and studies are underway to verify that this is

its mode of action in adult worms. Since DAF-18 is a homolog of PTEN, the second-most mutated tumor suppressor for human cancers, our studies on its function and activity in adult animals may provide insights about health preservation as humans age and about the physiology of cancer cells.

A-13: Neighbors, Rivals, and Frenemies: Investigating Social Networks in the Maritime Earwig

Author: Coonfield, Alissa; Iyengar, Vikram
Advisor: Dr. Vikram Iyengar

The spatial distribution of conspecifics can provide important insights into aggression and competition in social species, particularly those in which both sexes possess weaponry. The maritime earwig (Anisolabis maritima) lives in high densities under beach debris in coastal ecosystems, and both sexes are typically aggressive yet differ drastically in both forceps morphology and temperament. Previous research showed that the differential behavior of the sexes affect spatial distribution small confined groups, but interactions in more natural arrangements of free-moving individuals had not yet been examined. Given its natural history, the maritime earwig is well-suited for social network analyses, where the movement and proximity of individuals are tracked to determine how complex interactions within and between the sexes influence social and reproductive behavior. In this study, we assembled 30 groups of individually tagged male and female earwigs collected from San Juan Island, WA, varying the sex ratio in each of the groups (half comprised of a 2:1 ratio of females to males, and half comprised of a 1:1 ratio). We equipped each arena with a shelter comprised of four interconnected wooden boards. By lifting the boards and photographing the dispersion of the individuals beneath them, we tracked the position of all individuals in each group twice per day for 7 days. Assuming individuals cohabitating beneath the same board interacted frequently, we will use these data to map the social networks present in each group. This semester, we will continue by analyzing these networks to determine both the degree of centrality and cliquishness within each group. Specifically, our analyses will uncover: 1) how the conspecific interactions in this species can shape the behavior of individuals within a group over time and 2) how the number of females present can affect overall group dynamics. Because previous research found females to be more hostile and protective than males, we predict that a higher ratio of females will drastically alter the cliquishness and centrality of individuals in the group.

A-14: Material Properties of Sea Urchin Teeth

Author: Dineen-Carey, Marielle
Advisor: Dr. Alyssa Stark

Purple sea urchins (Strongylocentrotus purpuratus) are integral in maintaining biodiversity of marine ecosystems and shaping the physical environment around them. Specifically, sea urchins contribute to bioerosion of coastal rock formations by excavating depressions on sedimentary rocks. These pits function to protect the urchin from predators and high wave forces. Sea urchins use five self-sharpening teeth to erode rock. Previous studies have focused on the material properties of the tooth tip; however, it is unknown if material properties of the tooth change as a function of tooth length. Understanding how material properties change longitudinally along the sea urchin tooth will help us understand the function of their complex jaw structure, sea urchin population ecology, and could be used to design stiff bioinspired materials. We used a nanoindentor to measure hardness and modulus (i.e. stiffness) along the length of the tooth. Our data shows that hardness and modulus decrease as a function of distance from the tip. To resolve inconsistencies in the literature, we also compared the

material properties of teeth which were treated using three common preparation methods (fresh, frozen, and bleached). We found that bleached teeth differed in hardness and modulus when compared to fresh and frozen, calling into question previous work that used bleached samples. Future work is focused on investigating the source of the material property differences using energy dispersive X-ray spectrometry scanning electron microscopy (EDS-SEM) for spatial elemental mapping, and exploring population-level differences in tooth material properties related to native rock type.

A-15: Localization of ZC3H8 in PML Bodies
Author: Doan, Tyler
Advisor: Dr. John Schmidt

Fliz 1, encoded by the ZC3H8 gene, is a zinc finger protein that has been associated with breast cancer. In cancerous adult tissues, the ZC3H8 gene is amplified in 2-6% of solid breast tumors, yet the function remains relatively unknown. Casein kinase 2 is a protein that selectively phosphorylates serine and threonine residues and has been shown to be elevated in cancer as well. Furthermore, Fliz 1 contains a potential site for phosphorylation at threonine 32 where casein kinase 2 may activate Fliz 1 function. Here we use the casein kinase 2 inhibitors TBB and Quinalizarin to test for changes to Fliz 1 function and localization to nuclear bodies with PML, a protein that plays a role in cell cycle regulation, survival, and apoptosis. PML protein and Fliz 1, along with other proteins, colocalize with each other in puncta called PML bodies located in the nucleus. PML bodies are a variety of proteins that localize together and have been shown to be related to apoptotic pathways and transcription modification. We show that the localization and the number of PML bodies found in the nucleus changes with treatment of the casein kinase 2 inhibitors. Cells treated with either of the TBB or Quinalizarin display significantly fewer number of the PML bodies than untreated. Furthermore, we demonstrate that the low number of PML bodies can be rescued with removal of the inhibitors. Our results show that the number and localization of PML bodies with Fliz 1 protein is dependent on the phosphorylation state of Fliz 1. Since the phosphorylation state of Fliz 1 seems to alter PML bodies, this could serve as a connection between the function Fliz 1 and the aggressive cancer phenotype.

A-16: Tracing a neural circuit for courtship behavior in Drosophila
Author: Duckhorn, Julia
Advisor: Dr. Troy Shirangi

The gene dissatisfaction (dsf) in Drosophila is critical for the development of courtship behavior, but how dsf regulates the neural circuits that control behavior is unclear. I identified three pairs of dsf-expressing neurons in the abdominal nervous system of male flies that are critical for male courtship behavior. To find where these neurons lie in the circuit that controls the behavior, and to further investigate how dsf contributes to neural circuit development, I used a new, innovative neural circuit mapping tool in flies called trans-Tango. With trans-Tango, I was able to identify the neurons that are post-synaptic to the previously identified dsf-expressing neurons. This project will allow us to further investigate how the dsf gene regulates the function and connectivity of neural circuits for courtship behavior.

A-17: Understanding The Roles of Transcription Factors in Regulation of Healthspan
Author: Goldfarb, Jennifer
Advisor: Dr. Angela DiBenedetto

Human life is greatly improved when an individual's health remains in good quality up until death. This concept, known as healthspan, differs from lifespan which is defined as the amount of time an organism is alive for regardless of the quality of life. Recent improvements to extend human lifespan, without advances in healthspan, have left the elderly population of America in serious debt. The research presented here seeks to expand our understanding of healthspan regulation by transcription factors whose expression is increased with age. The research utilizes Caenorhabditis elegans as a model system as they have a very short lifespan (~18 days) allowing assays to be performed in a short amount of time while still observing the entire healthspan and lifespan of the organism. Additionally, C. elegans' lifespan is principally invariant which allows for the identification of mutants at low percentages of statistical significance. Furthermore, the Youngman lab has an RNAi library that contains RNAi against around eighty percent of the genes in the C. elegans genome, allowing for the ability to feed the worms bacteria containing specific RNAi that will knockout specific genes without causing undue strain to the animal. In this study, RNA was extracted from preadolescent [L4] and post-reproductive adult [Day 6 (D6)] worms to establish a list of transcription factor families that are upregulated from L4 to D6. Many of the identified transcription factors have orthologs in humans, suggesting that they may have conserved roles between C. elegans and humans. However, the roles of many of the selected transcription factors in age-related phenotypes have not been previously explored. Eight of the most promising transcription factors were knocked out in C. elegans using RNAi treatment. The lifespans of treated animals were carefully monitored to determine whether the targeted genes contribute to longevity. The treated C. elegans were also exposed to different heat and UV stress at L4 and D6 in order to assess their ability to resist stress at different life stages. The results of the mortality rates of the treated C. elegans are presented and discussed to conclude whether or not each of the eight transcription factors contribute to longevity.

A-18: Investigating potential genetic influences on inter- and intra-specific variance in boldness behavior of hybridizing songbirds
Author: Heuermann, Taylor M.; Curry, Robert L.
Advisor: Dr. Robert L. Curry

Animal personality, defined as consistent behavior within individuals but variable between individuals, influences how populations evolve in both predictable and changing environments. Boldness, one component of personality, measures tolerance for novel threats and may play a role in how individuals cope with change. As global warming shifts ranges and forces new species interactions, understanding mechanisms by which animals respond to change becomes increasingly important. In this study, I investigated boldness responses in pure and hybrid populations of Black-capped and Carolina chickadees. To measure boldness response, I used a motorized woodpecker decoy as a simulated threat at active nests. Although most assays elicited a pair response, audio and video recordings of each experiment provide individual-level detail in boldness response. Preliminary analysis indicates a difference in response between each of the pure and hybrid populations of chickadees. A secondary focus of this study is how variation in a personality-related gene, DRD4, contributes to differences in boldness response. Prior work in the Curry lab indicates that a single nucleotide polymorphism in DRD4 exists in different frequencies between Carolina and Black-capped populations—ongoing work

as a part of my study will determine if a relationship exists between boldness response and DRD4 genotype within populations.

A-19: Investigating the dynamics of lipid raft-based membrane order and ubiquitination on CD4+ anergy
Author: Karsalia, Ritesh
Advisor: Dr. Anil Bamezai

Significant cell to cell communication in tissues and organs of the body occurs through the plasma membrane. Additionally, the plasma membrane of a live cell is composed of an ever-changing network of saturated and unsaturated lipids, cholesterol, carbohydrates, and proteins that is critical for the regulation and compartmentalization of a myriad of cellular functions. Embedded within all membranes are dynamic, nanometer size domains known as lipid rafts, which contribute to membrane order and are enriched in sphingolipid, cholesterol, and proteins. These nanodomains are key regulators of many signal transduction pathways occurring near the membrane. Disruption of lipid raft-based membrane order is known to impede signaling events and cellular responses. Experimentation has revealed that CD4+ T cells exhibit an anergic, or unsuccessful, response correlated to increased membrane disorder as a result of inserting 7-ketocholesterol (7-KC) into the plasma membrane. My experiment examined the reversibility of this decrease in responsiveness through the cholesterol-mediated reconstitution of CD4+ T cell membrane order, after initial disruption with 7-ketocholesterol. Additionally, the mechanistic underpinnings behind reduced CD4+ T cell proliferation was investigated by searching for abnormal ubiquitination patterns on the key cell surface proteins participating in antigen recognition and CD4+ T cell activation. In preliminary experimentation, I was able to see an increase in cell proliferation and CD4+ activity when cholesterol was introduced to the membranes of CD4+ cells previously exposed to 7-KC. I also observed the presence of an ubiquitin-tagged protein in the membrane-proximal region during early CD4+ cell activation. Further experimentation and a deeper understanding of these pivotal immunological phenomena has great potential to refine current methods of defense against external pathogens, autoimmunity, and cancer.

A-20: Role of 7-Ketocholesterol in Blocking the Pro-Inflammatory Autoimmune Response Associated with Inflammatory Bowel Disease
Author: Lawrence, Audrey
Advisor: Dr. Bamezai

Inflammatory bowel disease (IBD) is a prevalent and debilitating disease. It affects more than one million people in the United States alone, and currently has no cure. IBD is a chronic inflammatory condition, proliferated by a dysregulation of the adaptive immune system's response to nonpathogenic flora in the gastrointestinal tract. CD4+ T cells, which are critical components of the body's adaptive immune response, misperceive commensal microbiota in the gut as threats and persistent stimulators of CD4+ T cells, resulting in their clonal expansion and differentiation to pro-inflammatory T helper cells (like Th17). Regulatory T cells, through secretion of interleukin 10 (IL-10) cytokine, suppress the pro-inflammatory environment in the gut. In the absence of this suppression, a chronic inflamed state can be reached. Mice deficient in IL-10 have inflamed guts and symptoms of IBD as observed in humans. Previous studies in the Bamezai laboratory have shown that 7-ketocholesterol (7-KC), a natural metabolite of cholesterol, can successfully disrupt lipid raft membrane order in vitro, promoting a disordered state. This forces the question of whether clonal expansion of pro-

inflammatory T helper cells can be disrupted through this method. I investigated the potential of 7-KC to suppress the inflammation in the gut. I have used the IL-10 KO animal model to test my hypothesis. Mice lacking IL10 genes were orally gavaged twice daily, 3 days a week for 3 weeks to deliver 7-KC. I observed a change in stool quality, the development of fatty pockets, and changes in tissue consistency of the treatment group in comparison with the IL-10 KO controls receiving saline. These preliminary findings reflect the potential of this line of inquiry. With the advent of new immunomodulatory biologics, this system will provide a much-needed platform to test the efficacy of this promising agent.

B-21: The role of endogenous siRNA in associative learning in Caenorhabditis elegans
Author: Manzanet, Yazmine
Advisor: Dr. Elaine Youngman

Pathogen exposure is an environmental stimulus that results in associative learning in the roundworm Caenorhabditis elegans, which is a well-accepted model for the study of simple behaviors. When C. elegans are presented with a choice between pathogenic and nonpathogenic strains of bacteria, worms with no prior exposure to pathogenic bacteria distribute evenly among the two food sources. However, worms that experienced infection by the pathogen earlier in life avoid the pathogen as adults when given this same choice of food sources. This type of learning is based on an increase in serotonin in the ADF chemosensory neurons: when genes necessary to make serotonin are knocked out, the worms do not learn to avoid the pathogen. However, the molecular circuitry that allows learned pathogen avoidance is completely unknown. Based on the known role of small noncoding RNA molecules in regulating other behavioral responses in the worm, I hypothesized that small RNA activity is required for learned pathogen avoidance in C. elegans, and further that small RNA activity is required for the infection-dependent increase in serotonin expression that is required for this learning. Using a genetic approach, I trained C. elegans mutants that are defective in small RNA pathways and compared their pathogen avoidance behavior to wild-type worms. Consistent with my hypothesis, the mut-7 strain, which lacks a large class of small RNAs known as the endo siRNAs, did not learn to avoid the pathogenic bacteria. This is in contrast to the wild-type C. elegans that were trained in the same manner but did display learned pathogen avoidance. These results suggest that small RNA activity is required in order for learned pathogen avoidance to take place, indicating that RNA-based regulation activity can play a critical role in animal behavior.

B-22: CgTHI10p and CgPMU3p Thiamine Responsive DNA Elements (TREs) are necessary and sufficient for thiamine regulation in C. glabrata
Author: Marcotte, Meredith; Iosue, Christine
Advisor: Dr. Dennis Wykoff

Candida glabrata is the second leading cause of candidiasis infections, though the number of drugs to target it is relatively few. Since thiamine (Vitamin B1) is essential to all living organisms, the Wykoff lab studies the thiamine pathway in Candida glabrata to identify possible drug targets. Previous research identified the Thiamine Responsive DNA Elements (TREs) in the promoters of the CgTHI10 and CgPMU3 genes. This study used homologous recombination to create plasmids in which the CgTHI10 and CgPMU3 promoters are driving the expression of YFP. The TREs in these promoters were deleted by replacing them with a PacI restriction enzyme site and fluorescence was measured using flow cytometry. The loss of expression in these plasmids demonstrates that the TREs are necessary for regulation. The TREs were then placed into the promoter of the opposite gene. The

genes regained expression with the insertion of the opposite TRE indicating that both TREs are sufficient to replace each other's function during thiamine starvation.

B-23: Chimeric Antigen Receptor Design for T Cell-Based Immunotherapy Against Her-2 Expressing Mammary Cell Carcinomas

Author: Morris, Julia; Zhengyu
Advisor: Dr. Matthew Youngman, Dr. Ma (Mark) Zhengyu (Nemours/Alfred I. duPont Hospital for Children)

The number of cancer survivors in the United States has increased in recent years–but so has the number of cancer diagnoses. Standard treatment for cancer still consists of chemotherapy and radiation therapy, which is highly toxic, has lasting detrimental effects, and is completely ineffective in some cases. Within the last year, however, the field of oncology saw the FDA approve the very first adoptive T-cell therapy (ACT), ushering a new era of personalized immunotherapies for cancer.5 In ACT, a patient's T-cells are genetically modified to express engineered chimeric antigen receptors (CARs) that recognize molecular markers indicative of transformed cancer cells. Despite this great advance, there are many challenges with immunotherapies, a primary on being "on-target, off-tumor" toxicity. This issue is prevalent in CARs, which target solid state malignancies, such as breast cancer, due to the low level of expression of tumor antigens in certain healthy tissues, leading to toxic and even fatal immune responses.3 We propose that by fine tuning the affinity and avidity of the specific CAR constructs, this toxicity can be mitigated, allowing for the safe treatment of solid tumors with CAR T-cell immunotherapy. We seek to examine the on-target, off-tumor effect in CARs of varying affinities directed against human Her-2, a common breast cancer marker also expressed at low levels in the lungs. This project in particular utilizes cloning, HiFi assembly, site-directed mutagenesis, and retroviral transfection to create seven CAR constructs with a range of affinities for later examination in human Her-2 transgenic mouse models for breast cancer.

B-24: Examining role of Tumor Necrosis Factor (TNF)-α cytokine in reduced cellularity and cell death observed in the thymus of Ly-6A transgenic mice

Author: Moxham, Sarah
Advisor: Dr. Anil Bamezai

Ly-6A is a 12 kD GPI anchored member of the Ly-6 superfamily. Ly-6A and other members of Ly-6 gene family show broad tissue expression, including its expression on T lymphocytes. Ly-6A has been characterized as a cell adhesion molecule. Additionally, Ly-6A superfamily proteins play a role in cell signal regulation, specifically cytokine secretion. Previous work in the Bamezai lab indicates that this protein's role in signaling regulation extends as far as cell death pathways, resulting in growth arrest and ultimately cell death in T cell lines. Expression of Ly-6A (also known as Stem Cell Antigen – 1) on T cells in the thymus is developmentally regulated. Ly-6A is expressed on progenitor "seed" cells and early thymocytes at high levels. As these cells mature in the thymus, Ly-6A expression ceases in the majority of double positive maturing T cells. Once the T cells are mature, expression re-appears – mostly on CD4+ T cells and only at low levels. Dysregulating the expression of Ly-6A in the thymus arrests T cell development at the most immature stage. T lymphocytes of Ly-6A transgenic mice (overexpressing,z Ly-6A on developing T cells) have been observed to experience increased instances of cell death. However, the underlying mechanisms of reduced cellularity in Ly-6A transgenic mice is unknown. I hypothesized that TNF-α, a cytokine known to have cell death inducing properties, contributes to the block in T cell development, lower cellularity and extensive cell death of developing

T cells in thymi of Ly-6A transgenic mice. To address my hypothesis, I investigated the levels of TNF-α in normal and Ly-6A transgenic mice. I find that there is generally a decrease in cellularity in the developing thymus of Ly-6A transgenic mice compared to Ly-6A wild-type mice. On a per cell basis, this finding corresponds with increased TNF-α release from transgenic T lymphocytes.

B-25: My Achy Breaky Crust: How does physical disturbance affect biocrusts and their associated microbial, fungal, and nutrient networks?
Author: O'Brien, Elizabeth; Detweiler-Robinson, Eva; Adelizzi, Rose; Rudgers, Jennifer
Advisor: Dr. Samantha Chapman

The fungal loop hypothesis suggests that soil fungi couple N-fixing biological soil crusts (biocrusts) with plants to increase productivity, since nitrogen is a limiting nutrient in drylands. We conducted soil disturbance experiments to understand the relationships between nutrient transfer in plants and biocrusts. We focused on three relationships within a disturbed environment: the influence of disturbance on microbial abundance, nutrient concentrations in soil samples, and the interactive effect between microbes and nutrients. We hypothesized that disturbance (stomping) decreases the overall productivity of a semi-arid system, concentrations of carbon and nitrogen in the biocrusts, and changes fungal communities. We leveraged an existing experiment that has been stomping biocrusts at 10 6m x 6m plots for 5y in the grassland and shrubland regions of the Sevilleta. We analyzed the natural abundance values for carbon and nitrogen, total microbial biomass, fungal abundance, and nitrogen cycling. To analyze fungal communities and colonization, we examined root fragments and cultured root fungi. Soil disturbance by stomping produced varied responses in this semi-arid ecosystem. Ergosterol content tended to increase with depth across both sites but was not dependent on disturbance. Fungal communities remained similar between treatments, but aseptate fungi was reduced in the disturbed plots. Ammonium concentrations are higher closer to the soil surface but are not dependent on disturbance. We plan on continuing this research with a 15N tracer experiment to explore the fungal loop more closely, continue isotopic analyses from roots, leaves, biocrust, and post-monsoon leaves, and identify sub-cultured fungi with DNA sequencing. Ongoing land use change and anthropogenic disturbance of biocrusts threatens the productivity and longevity of arid environments. This study and existing literature advocates for protecting biocrusts and their associated fungal and plant networks.

B-26: Examining effects of later Brd2 gene deficiency on zebrafish endothelial development with fli1a-GFP transgenic fish.
Author: Quatrella, Alexandra
Advisor: Dr. Angela DiBenedetto

Brd2 is a gene that is part of the bromodomain-external domain (BET) family of transcription coregulators and functions as a histone-oriented recruiter in chromatin modification complexes during transcription of target genes. Previous studies using the small molecule Brd2 inhibitor, BIC1, to reduce Brd2 activity over a 48-hour time window, demonstrated developmental abnormalities in the brain, pronephric duct, and especially the heart and circulation of treated embryos. However, this study did not allow for a quantification of the results, rather it only looked at phenotypically abnormalities. The present study aims to quantify the effects of the BIC1 inhibitor on the later development of the circulatory system in order to understand when and how Brd2 is affecting the critical time points for these circulatory vessel. Specifically, it will study the dorsal aorta, posterior cardinal vein, common cardinal vein, caudal artery, caudal vein and the intersegmental vessels. By combining BIC1 treatment

with endothelial GFP transgenic zebrafish, we obtain a detailed record of when and how endothelial cells are affected by the inhibitor throughout a 72-hour period post fertilization (hpf). Treatments are introduced at time intervals of 10hpf, 24hpf, and 36hpf. Zebrafish are then assayed at 24hpf, 48hpf, and 72hpf using a fluorescence-scanning confocal microscope to trace in 3D space the detailed vasculature and circulatory network in live embryos. GFP endothelial cells are fluorescently labeled when and allow for a clear view of individual cells as they are developing. Specifically, it will allow a quantification of the dorsal aorta, posterior cardinal vein, common cardinal vein, caudal artery, caudal vein and the intersegmental vessels. The goal of this experiment is to obtain information on how later intervention with the inhibitor effects endothelial development, with the intention of being able to define a critical window for Brd2 function. Given the role of Brd2 overexpression in blood cancers, including leukemia, in mice and humans, the information found here could uncover novel mechanisms of action for this oncogene in the wider context of circulatory system development.

B-27: Inducing apoptosis in mouse mammary tumor cells using the nuclear body protein ZC3H8

Author: Sato, Rhiann
Advisor: Dr. Janice Knepper

The zc3h8 gene encodes the fetal liver zinc finger protein, Fliz1, and is a presumed oncogene that is overexpressed in various mouse and human mammary tumor cell lines. Fliz1 is known to localize to PML bodies in cell nuclei, which are among a number of critical regulatory factors in tumor suppression and apoptosis. While Fliz1 is believed to be crucial in maintaining the integrity of PML bodies, overexpression of the zc3h8 gene has shown links to tumorigenic cell behavior and increased cell motility in breast cancer. To amplify and observe the effects of zc3h8 overexpression, we used mouse tumor cell lines equipped with an inducible tetracycline pathway, driving Fliz1 overexpression in response to the antibiotic, doxycycline. Negative control cells were compared against cells with Fliz1 in proliferation assays and Western blot analyses; while cells with Fliz1 demonstrated both increased proliferation and protein expression in the presence of doxycycline, both cell lines showed drastic decrease in viability and Fliz1 expression when treated with a high enough doxycycline concentration. We hypothesized that the overexpression of Fliz1 in mouse mammary tumor cells beyond a certain threshold correlates with resultant apoptosis. An apoptosis assay comparing cells with Fliz1 against negative control cells confirmed that both cell lines showed signs of apoptosis under high concentrations of doxycycline, but cells with Fliz1 underwent cell death much earlier and to a greater degree overall, presumably due to overexpression of zc3h8. These data suggest that the amplified overexpression of Fliz1 is associated with inducing apoptosis in mouse mammary tumor cells.

B-28: Investigation of root biomass and its role in combating rising seas

Author: Spanier, Nicole; Fell, Claire; Beadle, Azzeiza; Chapman, Samantha
Advisor: Dr. Samantha Chapman

Due to climate change, sea levels are rising and many plant species on Earth's surface are moving to higher latitudes. More specifically, in Florida, a decrease in extreme freeze events has been observed and has allowed mangroves, tropical coastal wetland plants, to move farther north into colder areas previously dominated by salt marshes. Mangroves, which are perennial woody trees, have different root structures than the herbaceous grasses commonly found in salt marshes. This change in dominant plant species composition is important, because root production in wetland coastal ecosystems can

help these plants maintain their position above rising seas. We investigated root biomass at three sites which vary in their latitude and in their level of mangrove encroachment. At each of these sites we took cores from mangrove-dominated plots (Avicennia germinans) and from plots dominated by two different marsh plants Batis maritime and Spartina alterniflora. Roots were measured at three depths, and the roots were categorized by fine versus coarse and dead versus alive. When comparing the total root dry biomass across each plant type at a depth of 0-15cm, where most roots occur, Spartina marsh plots contained a significantly higher total root biomass. When comparing the total root dry biomass across each site at a depth of 0-15cm, the Matanzas site, the southernmost site where mangroves are the most abundant, contained a significantly higher total root biomass. Our results imply that both the level of mangrove encroachment and plant species type can potentially influence root production and help maintain elevation with respect to sea level rise in coastal wetlands.

B-29: Purple Sea Urchin Spine and Body Allometry in Pits
Author: To, Prisca
Advisor: Dr. Carla Narvaez

"Sea urchins are dominant members of the rocky reef communities along the western coast of North America and play a large part in structuring subtidal ecosystem communities. The purple sea urchin Stronglyocentrotus purpuratus, actively excavate their natural substrate to create cavities, called "pits," to inhabit. These pits serve as protection against harsh water currents, predators, and allow the urchins to grow relatively undisturbed. In order for the pits to serve these purposes, the urchins must fit perfectly within the pit. What remains unknown is whether the dimensions of the cavities influence the length of spines relative to their test size. Urchins are known to have high phenotypic plasticity and the energetic requirements to grow in test diameter are greater than the energetic requirements to grow in spine length. Thus, our hypothesis is that as urchin size increases, the relative length of spines will decrease to create a "tight fit" of the urchin to the pit. Conversely, smaller urchins will increase their spine length relative to test diameter.
To test the effect of pit size on spine length and test diameter growth, urchins of varied sizes (10-25 mm test diameter) were placed inside artificial pits of equal size (~25 mm in diameter). Urchin growth rate in test diameter and spine length was measured once a week for a ten-week period.
Over the course of the experiment, the diameter of the urchins increased in a range from 0.98 mm to 2.5 mm. However, we found that the length of spines increased across all urchin sizes, even in larger urchins where spines ended up outgrowing the pit. Therefore, we conclude that, in this experiment, sea urchin spine and test allometry is not influenced by the pit profile. More research is needed to understand the dynamics of sea urchins and pit selection."

B-30: Effects of Primary Productivity on Bioerosion by Strongylocentrotus purpuratus
Author: Troha, Lukas
Advisor: Dr. Michael Russell

The purple sea urchin, Strongylocentrotus purpuratus, is a dominant member of the rocky intertidal in the Eastern Pacific. This species occurs on a variety of rocky substrates (sandstone, mudstone, granite) and is known to cause bioerosion by scraping their teeth against the rock. We sought to test whether food availability, in this case the availability of kelp, affects bioerosion rates among sea urchins over an 11 week period. Food availability serves as a proxy for primary productivity. We hypothesized that high food availability to an urchin would result in lower bioerosion rates. Units constructed with mudstone and sandstone substrates were used for individual urchins to reside on. The two treatment

types, "fed" and "starved" urchins, represent differences in availability of food in the wild. Fed urchins had a constant supply of food, and starved urchins had food only 24 hours a week. Consumption rates (grams of kelp/24 hours) were calculated for both treatments. Preliminary results show that, as expected, consumption rates of starved urchins were more than 0.5 g/24hr higher than fed urchins. Analysis of the inorganic content of feces and sediment produced in a non-erodible substrate versus an erodible substrate was conducted to determine bioerosion due to ingestion versus spine abrasion. Each urchin was isolated in a bucket on its native substrate and glass substrate for a 24 hour period, after which feces and sediment was collected. At the end of the 11 week period, the growth rates, gonad production, and jaw allometry of the urchins will be calculated, as well as the change in mass of the rock substrate. The decrease in primary productivity associated with climate change might have an important, but understudied, consequence in the bioerosion of Eastern Pacific rocky substrates.

B-31: The Characterization of Trypanosoma brucei Haloacid Dehalogenase
Author: Vicente, Alessandra; Palenchar, Jennifer
Advisor: Dr. Janice Knepper

Trypanosoma brucei is a parasite that is transmitted by the tsetse fly and causes African trypanosomiasis. Our laboratory is interested in characterizing enzymes in the parasite that have been acquired from bacteria through horizontal gene transfer. We selected a putative haloacid dehalogenase (HAD) that is essential in the trypanosome life cycle and shares sequence similarity with bacterial sources of the enzyme. In order to characterize the enzyme and validate its identity as an HAD, the gene encoding the protein was cloned into pET16b previously. The putative T. brucei HAD was overexpressed in Rosetta 2 DE3 cells and purified to approximate homogeneity using nickel affinity chromatography. A substrate screen was carried out, and the enzyme was shown to have phosphatase activity with several molecules, in accordance with HAD activity. Further, T. brucei HAD is metal dependent, requiring Mg2+ in order to carry out catalysis. A pH rate profile was generated and the optimal pH for enzyme activity is pH 7.5. Preliminary kinetic analyses were carried out with substrates pNPP (para-nitrophenol phosphate) and AMP.

B-32: Hormonal and neuronal control of sexual maturation in Drosophila
Author: Metkus, Mary
Advisor: Dr. Troy Shirangi

This project sought to understand the neuronal and genetic mechanisms controlling the maturation of animal reproductive behaviors. The maturation of female sexual behaviors in Drosophila, such as receptivity to mating attempts, were studied. I investigated which subpopulation of neurons a particular hormone is working in for behavioral maturation. I hypothesized that this hormone is regulating the anatomical maturation of a specific subset of neurons that regulate female receptivity. Through anatomical imaging and behavioral assays, I found that the hormone is working to mature a subpopulation of sensory neurons used for hearing, most likely for sensing male courtship rituals. Future experiments will elucidate how the hormone is maturing these neurons, as well as attempt to narrow the subpopulation of neurons further in order to understand how maturation occurs on a neuronal and mechanistic level.

Chemical Engineering

B-33: Use of Moringa Oleifera as a Natural Coagulant in Water Treatment
Author: Cullen, Elizabeth
Advisor: Dr. Dorothy Skaf

The purpose of this research was to examine the effectiveness of using natural coagulants in water treatment to provide an alternative to metallic salt coagulants. Moringa Oleifera is a common plant found in tropical regions whose seeds have an active positively-charged protein which has been shown to have coagulation and flocculation properties. In addition, the proteins have displayed biocidal properties which could mean a two-fold effect in water treatment. A jar test was used to examine the ability of Moringa Oleifera to reduce the turbidity of water dosed with a model contaminant, kaolin. Varying levels of turbidity were investigated ranging from low turbidity (30 NTU) to high turbidity (160 NTU). Alum solution, a commonly used coagulant, was used as a baseline to compare performance using Moringa seeds. Moringa Oleifera proteins were leached in both water and NaCl solution, to examine if one treatment provided higher reduction in turbidity. The preliminary runs resulted in a "U-shaped" curve when residual turbidity was plotted against dosage of coagulant. The alum solution was able to reduce turbidity to <1 NTU, but the Moringa Oleifera solution was not as effective only reaching 5-10 NTU. Based on literature, a procedure was constructed using UV-vis to quantify the amount of active protein leached from the Moringa seeds. Standard curves of protein concentration were constructed, but more data must be collected to achieve a better linear fit. Future work will involve developing better techniques to extract and quantify the active protein. Also, examination of the biocidal impacts will be investigated using a membrane filtration and dye-binding method.

B-34: Effect of MYB and p65 Transcription Factors on Trans-gene Expression
Author: McCracken, Reilly
Advisor: Dr. Jacob Elmer

Gene therapy is an experimental technique that involves the insertion of a gene into the cells of a patient. Extensive research on gene therapy has shown it to be a promising treatment for many genetic diseases, but the success of these treatments is typically limited by low levels of gene expression. One way to improve the efficiency of these treatments is to optimize the gene expression process. The aim of this project is to enhance transcription, the first step in gene the expression process, by utilizing MYB and p65 transcription factors. MYB and p65 aid in the transcription process by binding to motifs in the promoter region near target genes in a sequence-specific manner. Oligo annealing cloning was used to insert thirteen slight genetic variations of the MYB (10) and p65 (3) motifs into a plasmid at upstream and downstream locations relative to a human EF1α promoter that drives expression of a firefly luciferase gene. The plasmids were then transfected into prostate cancer (PC-3) cells using two different transfection agents: Lipofectamine and polyethylenimine. Approximately 48 hours after transfection, luminescence assays were completed to measure the effects of the MYB and p65 motifs on the expression of the luciferase (LUC) gene (relative to the native EF1 promoter). The results showed that the luminescence values for all of the MYB and p65 motifs located upstream of the EF1α promoter were greater than the control. Six of the upstream motifs (four MYB and two p65) were calculated to have statistically significant relative luminescence values ranging from 1.51 to 5.11. However, none of the motifs located in the downstream position of the promoter produced

statistically significant values for relative luminescence; in fact, many had lower luminescence values than the control.

B-35: Investigating the Adsorption Capacity of Hydrochar Made from Villanova Dining Hall's Foodwaste for Methylene Blue and Comparing with that of Powdered Activated Carbon (PAC)

Author: Nguyen, Huy
Advisor: Dr. Justinus Satrio

Powdered Activated Carbon (PAC) is the most common commercial adsorbent for different types of organic pollutants, including food dye like Methylene Blue (MB). However, the process of converting biomass to PAC requires a significant amount of energy because water content in biomass sources must be completely dried at high temperature (600 - 700 oC) before being put into the reactor. On the other hand, hydrochar is made from hydrothermal carbonization (HTC) process at lower temperature (160-300 oC) in which wet biomass can be placed directly into the reactor without drying the moisture content. Therefore, HTC is a much less intensive-energy process. In this research, hydrochar is made from accessible foodwaste sources at Villanova Dining Hall like Veggie Protein, Mixed Veggie, Fruit, Carbohydrate. If hydrochar made from foodwaste shows comparable adsorption capacity with PAC, then hydrochar can be potentially employed as a low-cost adsorbent.

B-36: Optimization of Naïve T Cell Growth

Author: Ostrom, Madeline
Advisor: Dr. William J. Kelly

Chimeric Antigen Receptor T cell therapy (CAR T cell therapy) is a type of immunotherapy that is used in the treatment of cancers such as leukemia. For the treatment, T cells are extracted from a patient's blood and transformed by adding a chimeric antigen receptor. This receptor is designed to attack the patient' cancerous cells once transplanted back into the patient. After the T cells are transformed, millions of the cells are grown in order to adequately fight the cancerous cells. These cells are then infused back into the patient's blood to kill any cancerous cells. The growth procedure that is currently used is somewhat inefficient, with up to 20% of batches failing and batches that do succeed taking a lot of time to grow to the necessary amount of cells. This project is focused on the optimal growth conditions to grow as many T cells as quickly as possible to streamline this therapy, focusing on naïve T cells specifically. A central composite design experiment was created using 28 different growth conditions. These conditions were diversified in Minitab with varying levels of the cytokines IL-2, IL-7 and IL-15 as well as varying antiCD-3/CD-28 bead to cells ratios. These conditions were chosen because the cytokines are all necessary for T cell growth and the beads simulate the surfaces of other cells since T cells grow best in clumps with each other. At the end of a 4 day growth period, Fluorescence Activated Cell Sorting (FACS) was then used for two different assays to determine the overall health and growth of cells for each condition. An Annexin-V/Propidium Iodide Assay to assess the number of live, apoptotic and necrotic cells. A Trypsin assay was used to break up cell clumps to get an accurate cell concentration to assess cell growth. Overall, it was found that a high bead to cell ratio had the greatest positive effect the growth and health of the cells. For future experiments, this procedure will be repeated for memory cells and then again for a co-culture of naïve and memory cells. The best conditions will be determined based on the comparison of results between all three experiments. This set of conditions will then be applied to the large scale growth of T cells for CAR T cell therapy to make sure patients can get their treatment as efficiently as possible.

B-37: Verification of Anti-Biofilm Formation of Coating Materials
Author: Portelli, Samantha; Zhang, Fangyuan; Huang, Zuyi
Advisor: Dr. Zuyi Huang

Bacteria are responsible for many of the diseases and ailments that affect living organisms. They grow as biofilms, or clumps of bacteria attached to a surface and surrounded by extracellular polymeric substance, and have become resistant to current antibiotic treatments. To combat the formation of these biofilms, researchers have begun to turn to alternate methods, specifically altering the surfaces of materials to resist or kill bacteria upon contact. Given materials--from Dr. Li's team of mechanical engineers--on which potentially antibiofilm coatings have been applied, our project focused on proving whether or not the coatings were able to resist the formation of biofilm. This was performed by culturing the materials with bacteria overnight, and using optical microscopy and SEM to view the bacteria attached to the surface. Based on the initial tests, only two of the coatings, MoSe2 and one of the two types of polyethylene coatings, were shown to strongly resist bacterial formation. With further testing and improvements, we hope to use our work and eventually find a coating that is suitable for use on medical devices to prevent biofilms from forming in the human body.

B-38: Materials for CO2 capture by Atomic Layer Deposition
Author: Sobota, Stephen
Advisor: Dr. Michael Smith, Dr. Charles Coe

Atomic layer deposition (ALD) allows for the synthesis of a nano-dispersed monolayer onto a support material. ALD does not compromise the pore volume of the support material and allows for the synthesis of high surface area materials with desirable chemical properties. ALD was used in the synthesis of various materials for CO2 absorption. The resulting materials are targeted to have a ten-fold rate enhancement with similar CO2 loading capacity. This will allow process intensification for producing H2.

B-39: 3D Printing with Polymer Nanocomposites
Author: Yoo, Nicholas
Advisor: Dr. Michael A. Smith

Polymer nanocomposites can offer immense applications in terms of its flexibility, electrical conductivity, and versatile mechanical properties. Traditional uses of pure polymer have only been for fast prototyping as the material does not offer many useful properties needed for a finished product. However, synthesizing polymer nanocomposites and using a 3D printer to manufacture products can be an exciting new direction for not only nanocomposites, but for 3D printing technology as well.

B-40: Production and Storage of LtEc as a Blood Substitute
Author: Curtis, Houston
Advisor: Dr. Jacob Elmer

The purpose of this study is to explore the manufacturing and storage of Lumbricus terrestris erythrocruorin (LtEc) as a blood substitute. Often times soldiers and other non-traditional patients face a distinct problem when it comes to receiving donated blood because of the inability to refrigerate for storage. Therefore, it would be desirable if there were a blood substitute that could remain stable and effective at high temperatures for an extended period of time. LtEc, compared to mammalian hemoglobin, is a much larger molecule with approximately 144 globins with disulfide bonds, linker

proteins, and Ca2+ binding sites. Therefore, it is a more stable oxygen-transporting protein that resists oxidation when stored at high temperatures. It has already been shown that purified LtEc can be exchange transfused into hamsters without any adverse side effects. We know that it works well in small animals, but for it to be useful for military, it needs to be stable (resistant to oxidation). To begin to address this question my project consisted of purifying LtEc blood from batches of 1,000 worms by using a juicer and Tangential Flow Filtration (TFF) for purification with a .65 micron filter and two 500 KD filters and analyzing the yield and oxidation levels of the purified protein. My results consisted of a yield range from 1.12 g to 2.12 of purified LtEc and oxidation levels ranging from 8%-11% oxidation. Acceptable oxidation rates are any which are under 10%. The subsequent aspect of my project consisted of exploring freeze-drying as a storage method for purified LtEc. In the past, LtEc was stored in the liquid form at high temperatures, however the freeze-dried product would be lighter and accessible during battle, however, re-suspension would be necessary. Freeze-drying can be very harsh on the protein; therefore, the effects of additives on the stability and oxidation of the protein before and after freeze-drying was explored. The additives included: ascorbic acid, DTT, sucrose, and glycine. UV-Vis spectroscopy was used to monitor oxidation of the LtEc before/after freeze-drying and re-suspension. Pure LtEc oxidized by about 10%, but when sucrose was added, it only oxidized by about 2%. Based on these findings the addition of sucrose continually stabilized the protein and decreased its' level of oxidation significantly more than any of the other additives. Therefore, there is potential for sucrose to allow for storage of the freeze-dried material for extended time without the risk of damaging the protein. Based on these findings it is possible to freeze-dry and resuspend LtEc without oxidizing it or aggregating it. The next step will be to test the resuspended material in animals to determine if it is safe in vivo, then eventually do clinical trials for humans.

Chemistry

C-41: Bulk Electrolyte Behavior in Lithium-Ion Batteries
Author: Abo, Kyle; Leitgeb, Austin; Jorn, Ryan
Advisor: Dr. Ryan Jorn

With increasing concerns over the usage of conventional fossil fuels, alternative sources of energy for automobiles, particularly lithium ion batteries, have accordingly become more prevalent. One common pair of electrolytes found in lithium ion batteries are ethylene carbonate (EC) and propylene carbonate (PC), which interact with the lithium salt LiPF6. The properties of these electrolytes are dictated by various solvation structures that exhibit the co-solvent preferences of the lithium cation. In order to observe such intermolecular interactions and the competitive solvation of lithium, LAMMPS simulations utilizing a previously successful force field were executed on EC and PC separately, both mixed with LiPF6, and varying different parameters in order to produce results similar to prior findings. Scaling the charge parameters on the constituent atoms of EC and PC yielded the most favorable results, indicated by the quantitative diffusion coefficients of the molecules and ions, as well as the qualitative radial distribution functions and coordination numbers. Other trials were subsequently conducted in which the concentration of PF6- was varied and mixed with either EC or PC, exhibiting an inverse relationship between diffusion and PF6- concentration. The EC carbonyl oxygen and PF6- phosphorus also showed an inverse relationship with respect to coordination to the Li+. Ultimately, the solvation preferences of both EC and PC were displayed through three different ratios of EC/PC mixtures with LiPF6. These results were then used to inform simulations of the electrode interface. Future work will consider application of this charge scaling method to other systems.

C-42: Synthesis and Characterization of Novel Ruthenium Polypyridal
Author: Benson, Kaitlyn; Stache, Jackie
Advisor: Dr. Jared Paul

Water oxidation catalysts are of great interest in the alternative energy field. Ruthenium based water oxidation catalysts have been found to have the ability to cycle between low and high oxidation states needed for catalysis. Our laboratory focuses on the design of ruthenium complexes that make the water oxidation more accessible. These complexes are designed with bipyridine ligands coordinated to ruthenium containing one or two functional groups substituted at the 4 and 4' positions. We use electron donating functional groups on the ligand to increase the electron density at the metal center, making the water oxidation process easier. Four pH dependent polypyridyl ruthenium complexes were synthesized and studied in this work. [Ru(bpy)2(bpy(OH))]2+ (bpy = 2,2' -bipyridine; bpy(OH) = 4-hydroxy-2,2' -bipyridine), [Ru(bpy)2(bpy(OMe))]2+ (bpy(OMe) = 4-methoxy-2,2' -bipyridine), [Ru(bpy)2(bpy(OH)2)]2+ (bpy(OH)2 = 4,4' -dihydroxy-2,2' -bipyridine), and [Ru(bpy)2(bpy(OH)(OMe))]2+ (bpy(OH)(OMe) = 4-hydroxy-4' -methoxy-2,2' -bipyridine) were synthesized as both hexafluorophosphate and chloride salts. Fundamental studies, including concentration and pH dependent UV-Vis, were carried out to develop and understanding of the electronic properties of these complexes.

C-43: Investigation of Sr2Fe2-xMxO6-δ (M= Cr, Mo, W) Solid Oxide Anode Catalysts
Author: Bradley, Marissa; Pierre, Darne; Legaard, Emily; Eigenbrodt, Bryan
Advisor: Dr. Bryan Eigenbrodt

With the current deteriorating state of our environment and an increasing demand on a limited supply of fossil fuels, finding technologies that utilize renewable resources efficiently while producing minimal pollution is of great importance. Of the available alternative energy technologies, solid oxide fuel cells (SOFCs) have attracted considerable attention because of their ability to provide electricity from a variety of different fuels with high conversion efficiencies. Currently, traditional SOFC anode catalysts do not support the direct use of complex hydrocarbon fuels, which can lead to eventual device failure brought upon by unwanted graphitic and metal sulfide formations. These limitations in the anode catalyst have spurred the investigation of advanced mixed ionic and electronic conducting (MIEC) anode materials that can be effective at blocking these detrimental formations. In these studies, group VI metals (M = Cr, Mo, and W) will be introduced into the crystal structure of Sr2Fe2-xMoxO6-δ (SFMO) and the effects of these metal additions on electrochemical properties of this SFMO material will be investigated. Initially, the ability to synthesize these materials will be explored and verified for phase purity with X-ray diffraction. Once pure, these anode materials will then be integrated into working SOFC devices where their electrochemical performance will be tested. The use of operando X-ray absorption spectroscopy measurements will also be utilized to provide unparalleled insight into the fundamental catalytic chemistry of SFMO at 800°C while also under reactive atmospheres.

C-44: The Mechanochemical Coupling of Proteasomal Degradation and ATP Hydrolysis
Author: Braganca, Chris; Kraut, Daniel
Advisor: Dr. Daniel Kraut

The Ubiquitin Proteasome System (UPS) is the canonical pathway for protein degradation in eukaryotic cells. Proteins targeted for degradation are first tagged with a polyubiquitin chain through

a series of enzyme-catalyzed reactions before degradation. After polyubiquitination, the 26S proteasome hydrolyzes ATP to processively degrade substrates. In this project, we manipulated the ATP concentration to examine the mechanochemical coupling of ATP hydrolysis and substrate degradation. To manipulate the ATP concentration in vitro, we gradually substituted ATP for ATP-γ-S, a non-hydrolyzable analog of ATP, until the proteasome was exclusively exposed to ATP-γ-S. Our substrate contained green fluorescent protein, making it possible to detect fluorescence, and an Neh2Dual region, to allow for different modes of ubiquitination. We used a Keap1 E3 ligase for canonical K48 linkages, and an Rsp5 E3 ligase for K63 mixed linkages. With 0% ATP, the Keap1 substrate and the Rsp5 substrate saw a 60% decline in degradation. The Rsp5 substrate, however, is special because we it allows us to monitor the release of fragment (minimally degraded substrate). Further assays will be conducted to determine mechanism of ATP hydrolysis.

C-45: Piperazine-Based BisQACs: Potent Antimicrobial Compounds
Author: Brian, Bentley; Kontos, Renee; Feliciano, Javier
Advisor: Dr. Kevin Minbiole

The emergence of bacterial resistance toward commonly used antimicrobial agents is a pressing concern for human health. The lack of investigation into this antiseptic trend may lead to serious consequences in the future. While longstanding antiseptic quaternary ammonium compounds (QACs) such as benzalkonium chloride provide a single cationic nitrogen to confer amphiphilicity, we have observed that multicationic structures ("multiQACs") are more effective in their ability to kill bacteria and eradicate biofilms. Common household cleaners with "monoQACs" show weaker efficacy against Gram-negative bacteria as well as diminished effectiveness against MRSA strains, compared to other S. aureus strains. Contrastingly, it has been found that multiQACs show little or no susceptibility to bacterial resistance, which is capable of reducing the efficacy of many quaternary ammonium compounds. The 20 presented compounds are novel QAC's. These newly synthesized biscationic (bisQAC) species presented an aptitude for potent activity against the 5 bacterial strains tested, with a quarter of the compounds possessing single-digit micromolar activity against all strains. Optimal efficacy was observed at chain lengths of 12 and 13 carbons, while chains with amide linkers displayed higher activities than their hydrocarbon counterparts. These findings support the past indications that simple multiQAC architectures can show improvement over the current monoQAC household antiseptics.

C-46: Winsor & NewtonTM Artisan Water Mixable Oil Colour: Studies on Ethoxylated Surfactants and Fatty Acids
Author: Cresti, Julianna; Sundberg, Brynn; Lagalante, Anthony; Wolbers, Richard
Advisor: Dr. Anthony Lagalante

The purpose of this study was to determine what property or chemical component gives water-mixable oil paints (WMOs), like Winsor & NewtonTM Artisan Water Mixable Oil Colours, the ability to emulsify with water. This knowledge can prove useful in assessing future conservation and preservation concerns with this new media, as well as formulating cleaning solutions that are safe and accessible for use by trained conservators. The major focus in analysis was investigating potential compositional differences or modifications between proprietary WMOs and typical linseed triglyceride drying oils that lack solubility in water. This research posed the important question: if surfactant molecules or surfactant functionalized modifications, which are believed to be responsible for the suspension of water in oil, are removed by solvents, how will the color, gloss, and integrity of the paint

film respond, if they do at all? A series of physical tests that included colorimetry and gloss measurements of paint films exposed to cleaning solutions of varying pH and organic solvent composition was performed. Additionally, model soiling studies were performed by measuring luminosity of fluorescently tagged fingerprint powder in WMO paint films. Soil entrainment as a function of relative humidity and temperature was measured by fluorescence microscopy. These soiling tests, however, did not show any significant trends with respect to changing relative humidity and temperature suggesting movement of the surfactants through the paint film. This demonstrated the paint's similarity to other drying oil paints and not modern acrylics. In addition, gloss appeared to change the most at high pH values, following the extraction trends of ethoxylated surfactants at higher pH's. Quantitative instrumental methods of liquid chromatography tandem mass spectrometry and gas chromatography mass spectrometry were used in the portion of the experiment focused on studying the extraction of the WMO surfactant and the modifications of the linseed drying oil. LC-MS/MS was used to identify poly(ethylene glycol) (PEG) and poly(ethylene glycol) methyl ether (mPEG) surfactants within WMO paint films, . Paint films were exposed to various pH and organic solvent conditions; LC-MS/MS data collected quantified the amounts of surfactants extracted as conditions changed. As pH increased, more surfactant could be extracted, while organic solvent exposure did not produce an obvious trend. Gas chromatography mass spectrometry was used to identify fatty acid methyl ester derivatives of the specialized WMO modification of linseed oil. Fatty acid contents of linseed oil versus WMO linseed oil were rather similar, but the WMO oil contained unique isomers of linolenic acid. UATR-FTIR spectroscopy further supported a trans isomer at wavelength 966 cm-1. Data revealed that ethoxylated surfactants PEG and mPEG are not components of the WMO linseed oil, which poses questions for further research as to how these become incorporated in the WMO paint films and their ultimate fate in the long-term stability of artwork.

C-47: Effects of Ocean Biology and Water Temperature on Sea Spray Aerosol Composition
Author: Haas, Savannah; Kripes, Rachel; Remenapp, Allison; Rauschenberg, Carlton; Kulju, Kathryn; Matrai, Patricia; Boschi, Vanessa; Grannas, Amanda; Ault, Andrew; Pratt, Kerri
Advisor: Vanessa Boschi, Amanda Grannas, Kerri Pratt

Sea spray aerosols (SSA) are a major contributor to natural aerosols in the atmosphere and have climate effects such as scattering solar radiation and forming cloud droplets. Little research has been conducted on sea spray aerosol chemistry in cold environments, such as the changing Arctic or wintertime North Atlantic, and knowledge of individual particle size and composition is needed for understanding the magnitude and mechanisms of the climate effects. The presence of organic compounds greatly contributes to the climate altering properties of SSA, by impacting particle hygroscopicity, reactivity, light scattering, and gas to particle mass transfer. To study winter North Atlantic SSA, experiments were performed at room temperature and outdoors (near freezing) at the Bigelow Institute for Ocean Sciences in Maine in January 2018 using a marine aerosol reference tank (MART), local seawater, and various concentrations of added dissolved organic material from a phytoplankton culture. The MART mimicked wave action through a plunging waterfall mechanism to simulate SSA production. SSA particles were collected using a five stage cascade impactor and an eleven stage micro-orifice uniform deposition impactor for offline, size-resolved chemical analysis. Samples extracted from the filters were analyzed for soluble inorganic ions using ion chromatography. Individual particle composition was determined using Raman microspectroscopy and scanning electron microscopy with energy dispersive X-ray spectroscopy. The impacts of particle size, water

temperature, and amount of added organic matter on ion concentrations and individual particle composition will be discussed.

C-48: Investigating the role of p97 in proteasomal degradation of NRF2
Author: Ximena, Jordan; Kraut, Daniel
Advisor: Dr. Daniel Kraut

The 26S proteasome is responsible for most protein degradation in eukaryotic cells. The canonical degradation cycle consists of substrate recognition, binding, engagement, polyubiquitin chain removal, protein unfolding, followed by translocation, degradation and peptide release. The ATP-dependent unfoldase p97 has been shown to regulate the transcription factor NRF2 in cooperation with the proteasome in cell culture. The uncontrolled expression and accumulation of NRF2 has been shown to promote the proliferation of cancerous cells. Understanding the role of p97 in protein degradation can help us further understand the ubiquitin driven degradation of NRF2 and its interaction with the adapter protein Keap1, which is responsible for its ubiquitination. p97 and its cofactors NPL4/Ufd1 and UBXN7 were purified for all assays. Endpoint degradation assays were conducted to observe degradation by the proteasome in the presence of p97. Pulldown Assays were also used to observe the interactions between p97/Keap1/NRF2 in the complex. The results from the endpoint assays indicated that p97 was inhibiting degradation rather than promoting it. In contrast, the pulldown assays suggest that p97 is responsible for removing Keap1 from the p97/Keap1/NRF2 complex. The cofactor UBXN7 was shown to be important for the function of p97.

C-49: Synthesis of Analogs of the Phytotoxin Diplopyrone
Author: Kopplin, Noa; Giuliano, Robert
Advisor: Dr. Robert Giuliano

Diplopyrone is a phytotoxin isolated from the fungus Diplodia mutila and reported by Evidente and co-workers in 2003. D. mutila is considered to be responsible for cork oak decline in parts of southern Europe where the disease has widespread and negative economic and environmental impacts. The pyranopyran core structure found in diplopyrone also occurs in many other natural products that encompass a range of biological effects including antibiotic activity. Viewing diplopyrone as a "C-glycoside problem" opens up multiple synthetic routes that are based on carbohydrate starting materials. Recently our laboratory completed the synthesis of the enantiomer of diplopyrone from carbohydrates and we are now preparing analogs for biological testing in collaboration with the USDA.

C-50: Synthesis of Novel N-Heterocyclic Carbene Ligands used for Atomic Transfer Radical Polymerization Catalysts
Author: Lazenby, Ellis
Advisor: Dr. Eduard Casillas

The focus of this project is to synthesize multiple derivatives of novel ligands all containing the same expanded ring N-heterocyclic carbenes. The target NHC ligand is a seven-membered carbene ligand with various derivatives of an aromatic benzylamine substituted. The synthesis begins with two reactants, a monosubstituted diamine and a salicylaldehyde derivative, and is carried out with the following six steps: condensation, imine reduction, silyl deprotection, cyclization, deprotection, and metalation. The progress made so far mainly involves the creation of many reactants. Three out of four of the protected aldehydes have been made. The coupling partner, the monosubstituted diamine,

has also been created, but with poor yields. Future progress for this project involves finding a new method to make the monosubstituted diamine, and then continuing to evaluate and optimize the proposed synthesis to obtain the final product.

C-51: Effect of Nitrogen Medium Concentration on Cell Growth and Lipid Composition of Nannochloris eucaryotum
Author: Legaard, Emily; Eigenbrodt, Bryan
Advisor: Dr. Bryan Eigenbrodt

Our world today relies almost completely on fossil fuels, a resource which is depleting in supply and negatively affecting our environment. For these reasons, a renewable, environmentally-friendly fuel source must be found. The research presented will explore the effects that nitrate concentrations (between 11.80 and 2.80 mM) will have on the cell density and lipid production and accumulation in the algae species Nannochloris eucaryotum. A suite of analytical techniques including fluorescence spectroscopy, transmission electron microscopy, and gas chromatography coupled with mass spectrometry will be used to qualitatively and quantitatively explore the extent of these effects on the lipid production mechanism and storage mechanism inside these cells. Understanding the fundamental chemistry behind increasing lipid storage in these algal systems will aid in the utilization of this renewable resource for future biofuel generation.

C-52: Comparison of Solvation Structure in Bulk and at Surfaces in Mixed Carbonate Solvents
Author: Leitgeb, Austin; Abo, Kyle; Jorn, Ryan
Advisor: Dr. Ryan Jorn

Mixed solvent systems within a galvanic cell remains a poorly characterized field of research which can lead to an increase in electrical output and energy density. Two solvents that have been studied extensively for this system are Propylene Carbonate (PC) and Ethylene Carbonate (EC). PC is a solvent that is highly reactive in a metal ion battery. Its reactivity damages the battery in the charging process because it can break down the graphene layers. EC is a necessary solvent to test in addition with PC in an electrolytic cell in order to reduce the volatility of PC. Producing a more efficient battery will allow greater electrical output per battery charge. This will allow battery operated cars to travel farther and in turn make them more competitive in the automobile market. Results are presented for mixtures of these solvents based on computational simulations at graphite interfaces. The systems were simulated in the presence and absence of a bias voltage. The changes in solvation structure of PC and EC at the interface were contrasted with bulk.

C-53: Electronic Properties of a Ruthenium Hydroxyl-Substituted Polypyridal Complex to Gain Insight Towards the Development of Water Oxidation Catalysts
Author: Montgomery, Charlotte
Advisor: Dr. Jared Paul

Ruthenium complexes, which can occupy multiple oxidation states, are frequently used to form single site catalysts. The ligands coordinated to the ruthenium center play a central role in dictating the electronic properties of these complexes. A fundamental understanding of the effects of changes in ligand properties can be used as design principles for more efficient water oxidation catalysts. It is difficult to study the properties of water oxidation catalysts due to the very nature of their reactivity: they are always changing. So, it is necessary to study these complexes as hydroxyl-substituted polypyridyl ligands coordinated to ruthenium because they are one variable systems. The purpose of

this research project was to analyze the effects of the ligand, tphoxy (4'-(4-hydroxyphenyl)-2, 2':6', 2''-terpyridine). This electron donating ligand, consisting of an extra phenol, can help stabilize the ruthenium center at high oxidation states. Also, the multiple protonation states of the ligand are a potential way of controlling catalysis as an on/off switch. I synthesized two complexes using this ligand, [Ru(tpy)(tphoxy)][Cl]2 and [Ru(tphoxy)2][Cl]2. Then, I characterized them using using infrared spectroscopy, nuclear magnetic resonance spectroscopy, ultraviolet/visible absorbance spectroscopy, cyclic voltammetry, pH titrations, and Pourbaix diagrams. These studies showed how incremental changes upon the addition of the phenol benefit and hinder complex properties for future catalyst design.

C-54: Hydorphobic ZnO Nanoparticles: Building Blocks of 2D and 3D Semiconducting Supercrystals
Author: Nguyen, Joseph H.; Ahmadi, Temer S.
Advisor: Dr. Temer S. Ahmadi

ZnO semicoducting nanoparticles coated with stearic or lauric acid were prepared in methanol and then co-coated with dedecanethiol in octanol in order to enhance their surface hydrophobicity. These colloidal particles were characterized by uv-vis, fluorescence, DSC, TEM and Raman/IR spectroscopy. Our results indicate formation of hydrophobic ZnO colloidal nanoparticles of quantum-confined sizes (~5 nm in diameter). Our data and future use of these nanoparticles will be presented and discussed.

C-55: Qualitative and Quantitative Determination of Lead Extracted from Samples of Leaded Brass Using Mercury Coated Micro Electrodes
Author: Nobile, Vincent
Advisor: Dr. Anthony Lagalante

Qualitative and quantitative methods for the determination of lead in various solutions were tested using X-ray Fluorescence (XRF) spectroscopy and anodic stripping voltammetry. The goal was to determine a method that could quantify lead ions in field samples. It was determined that the XRF spectrometer used was not sensitive enough to detect lead at the sup-ppm level which would most often be found in field samples. However, it was found that by using a mercury coated (mercury drop) micro-electrode both qualitative and quantitative results could be obtained via anodic stripping voltammetry. This method was tested by analyzing the effect of pH on the leaching of lead from samples of leaded brass. As expected, a lower pH, on average, resulted in a higher concentration of lead leached into aqueous solutions. This ppb level of leaching was quantifiable using anodic stripping voltammetry.

C-56: Purification and Characterization of a Putative Burkholderia cenocepacia
Author: Onwunaka, Chiamaka; Palenchar, Jennifer
Advisor: Dr. Jennifer B. Palenchar

A putative beta-hydroxybutyrate dehydrogenase (HBDH) from the bacteria Burkholderia cenocepacia was previously crystallized by the Seattle Structural Genomics Center for Infectious Disease (SSGCID, PDB accession 4TRR). With the construct provided by the SSGCID, we sought to determine if the crystallized protein is a beta-hydroxybutyrate dehydrogenase. The His-tagged protein was overexpressed in E. coli and purified to approximate homogeneity using nickel affinity

chromatography. Enzyme assays monitoring the NAD+-dependent conversion of hydroxybutyrate to acetoacetate reveal that the putative Burkholderia cenocepacia HBDH is a bona fide beta-hydroxybutyrate dehydrogenase. Future work will determine the kinetic parameters of the enzyme.

C-57: Optimization of pyrrolizidine alkaloid detection by LC-MS
Author: Sanchez, Hugo; Tasca, Julia A.; Minbiole, Kevin
Advisor: Dr. Kevin Minbiole

Pyrrolizidine alkaloids (PAs) are important secondary metabolites that mediate plant/herbivore interactions. The family Apocynaceae contains many species of plants that utilize PAs in defense against predators, yet the Danaus plexippus (monarch butterfly) species of specialist herbivores target members of Apocynaceae to increase their own fitness through the consumption of PAs. Leaves from various species of the Apocynaceae family of various ages were analyzed via liquid chromatography-mass spectrometry (LC-MS) to determine presence or absence of PAs. There are a number of potential reasons for changes in PA presence/absence including age, microbial degradation, preservation methods, or genetic polymorphisms. If PA detection is linked to genetic polymorphisms, it would support the defense de-escalation hypothesis, a sub-theory of the evolutionary arms race, where organisms decrease the production of ineffective defense chemicals in order to preserve energy.

C-58: Synthesis and amine functionalization of a co-poly(oxetane) for use in antimicrobial polyQACs
Author: Shastri, Vaidehi; O'Donnell, Katelynn; Zubris, Deanna
Advisor: Dr. Deanna L. Zubris

Quaternary ammonium compounds have long been used in disinfectants, but the antibacterial activity of multi-cationic quaternary ammonium compounds (multi-QACs) has recently been investigated with promising results. The properties of these compounds can be employed in the underexplored area of polymer coatings for use in biofilm-resistant materials. A new approach to creating these polyQACs is described here. This new approach involves the synthesis of a co-poly(oxetane) based copolymer followed by substitution using various amines to install multi-QAC functionality. The synthesis and characterization of this copolymer and attempts at amine functionalization are outlined here.

C-59: Development of Two Ligands for Iron Catalyzed Atom Transfer Radical Polymerization
Author: Shavin, Anna; Boyko, Walter; Zubris, Deanna
Advisor: Dr. Deanna L. Zubris

In Atom Transfer Radical Polymerization (ATRP), a metal-based catalyst helps to mediate a controlled ("living") free-radical polymerization, providing scientists with polymer products whose weights are precisely controlled. The Zubris group looks to further hone guiding principles for successful iron based ATRP, with particular interest in ligand design. To this end, we focus on the parameters of electron donation and sterics as key determinants in the outcome of catalytic activity in ATRP reactions. Electron donating thiomethyl- and thiophenyl- substituted bis(imino)pyridine ligands are reported as catalytically active in the polymerization of olefins, and this offers hope for their activity when used in ATRP. Here, the successful synthesis and initial characterization of an electron-donating, thiolphenyl-substituted ligand is presented. Characterization of the proposed thiomethyl-substituted ligand is also included. Further, initial data supports the presence of E – and Z –isomers. Ongoing work to assess the impact of the electronic environment on eventual ATRP, as well as the development of a computational model for the structure of the ligand, continues.

C-60: Synthesis of Isotopically Labeled Precursors for the Characterization of the Halonium Ions

Author: Sise, Henry
Advisor: Dr. Brian Ohta

The structure of intermediate halonium Ions have been proposed to be a closed bridged structure. However, through the use of isotopic perturbation equilibrium, strong evidence support the conclusion that, with certain olefins, the halonium ion structure is a rapid shifting equilibrium of a β-halocarbenium ions. Current research aims to determine if other halonium ion species, specifically with cyclic halonium ions, are also rapid equilibria. Toward these aims, the first step in the project is to synthesize isotopically halonium ion precursors.

D-61: In Vitro Potency of Small Molecule Factor D Inhibitors using a FD Thioesterolytic Assay. Synthetic Efforts in the Hit to Lead Optimization Process

Author: Snakard, Olivia; Ung, Victoria; Richardson, Ashley; Kraut, Daniel
Advisor: Dr. Konstantinos Agrios, Dr. Daniel Kraut

The alternative pathway (AP) of the complement system provides an innate immune defense mechanism in all vertebrates. Factor D (FD), an S1 protease plays a central role in AP amplification by catalyzing the first and rate limiting proteolytic step. A few drug discovery labs have suggested FD inhibition to be a viable mechanism to block the complement AP with high specificity and efficiency leading to the development of therapeutics for rare diseases such as age-related macular degeneration (AMD) and paroxysmal nocturnal Hemoglobinuria (PNH). Professor Agrios' medicinal chemistry laboratory has been working to develop novel inhibitors for the factor D enzyme. The assay development and biochemical testing of all synthesized analogs is performed in Professor Kraut's laboratory. In this poster, we will present the thioesterolytic assay protocol as well as in vitro data for selected compounds. Moreover, we will discuss some synthetic efforts towards optimization of our hit structures aiming in improving their binding in the S2' pocket of the FD enzyme.

D-62: Synthesis and Characterization of a Bimetallic Ruthenium Complex with an On/Off pH Switch for Catalytic Water Oxidation

Author: Teahan, Claire; Paul, Jared
Advisors: Dr. Jared Paul

Future reliance on the sun's energy as a sustainable alternative to fossil fuels is dependent on the development of highly efficient water oxidation catalysts. These catalysts are needed to convert the sun's energy into storable solar fuels. The water oxidation process liberates four protons and four electrons which in turn can be used to produce hydrogen gas. This hydrogen gas is a clean, storable form of energy. 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. The purpose of my research is to synthesize potential bimetallic water oxidation catalysts using bipyrimidine as the bridging ligand. Specifically I am interested in [(bpy)2Ru(bpm)Ru(tphoxy)(H2O)]4+ (bpy = 2,2'-bipyridine, bpm = 2,2'-bipyrimidine, tphoxy= 4'-(4-hydroxyphenyl)-2, 2':6', 2''-terpyridine), which is a ruthenium based bimetallic complex with a site for water to bind. The hydroxyl-substituted terpyridyl ligand, tphoxy, has the potential to produce an on/off switch tunable by changes in pH making this a more effective catalyst as there may be an additional level of control. After the complex was synthesized, it was characterized in several ways

including nuclear magnetic resonance spectroscopy and infrared spectroscopy. Preliminary studies have been performed in order to detect the production of oxygen by the complex. The future direction of this research is to do further oxygen studies and a complete characterization of the complex.

D-63: Towards Ruthenium Tris(2-pyridyl)phosphine Complexes as Water Oxidation Catalysts

Author: Wilkinson, Lawson; Bezpalko, Mark; Leonard, Julia; Kassel, Scott
Advisor: Dr. Scott Kassel

Face-capping ruthenium complexes of several tris(2-pyridyl)phosphine (PPy3) derivatives have been examined for their potential as water oxidation catalysts. The complexes are attained by the direct substitution of PPy3 into [Ru(η-C6H6)Cl2]2 or through using an appropriate ruthenium solvate (acetonitrile or dimethyl sulfoxide). Complexes of several pyridyl substituted tris(2-pyridyl)phosphines (e.g. 4-Methylpyridyl) and associated oxide, sulfide, or selenide derivatives were prepared. The isolated products were characterized using UV-visible, fluorescence, and 1H and 31P NMR spectroscopies. Electrocatalytic activity was determined using cyclic voltammetry.

D-64: Impact of Morphology on GSI Infiltration

Author: Wong, Jeremy; Smith, Virginia
Advisor: Dr. Virginia Smith

Green Stormwater Infrastructure (GSI) is an increasingly important solution for hydrologic and water quality control for municipalities and watershed planners, and designers. While the effectiveness of these systems in addressing event-based hydrologic occurrences has been widely studied, little is known about the long-term sustainability of GSI and less about the how morphological changes impact the performance of such systems over an extended period, which could potentially impact the success of the GSI. This work is part of a study that utilizes a quasi-3D morphodynamic model to predict long term morphological changes in a rain garden and relates these changes to the performance of the rain garden using a series of field measurements of infiltration rates, flow, and soil properties within the GSI. For this study several tests were done on soil samples from operational and failed sites in Fishtown, PA, that are part of the I-95 rehabilitation project, to determine the sites' soil density, water content, organic content, plastic limit, liquid limit, etc. This information was then evaluated against the GSI specification and model outputs to help determine their morphological and compositional changes. The model used is a continuous quasi-3D morphodynamic model that was created in the International River Interface Cooperative (iRIC) software using high resolution LiDAR elevation data and a continuous record of storm water inflow data. A spatial analysis of morphological changes is then performed by combining the model results with post-construction in-situ infiltration test results to determine a relationship between the morphological changes and infiltration rates over time. The findings of this study are important to understanding how potential changes in soil characteristics due to GSI morphology impact the GSI sustainability. More importantly, this study presents an important starting point for quantitatively predicting lifespan and maintenance requirements for GSI. The study will also shed light on the role of sediment inflow on the overall sustainability of GSI and how GSI can be optimally designed to reduce the impact of morphological changes on performance.

Civil & Environmental Engineering

D-65: Evaluating Stream Flashiness at the Headwaters in Developed Watersheds
Author: Brockett, Hailey
Advisor: Dr. Andrea Welker

Villanova University is currently monitoring the Chrome Run and three additional streams located within the Delaware River watershed to assess the impact of updated stormwater control measures that will be constructed on stream health. The Granite Run Mall is located on 58 acres at the Chrome Run headwaters. The mall site is nearly 100% impervious cover and was designed in accordance with the stormwater regulations of the 1970s. The site is currently being redeveloped into the Promenade at Granite Run which presents a unique opportunity to examine the effectiveness of the associated updated stormwater management practices. Villanova is currently performing a robust Before-After-Control-Impact study to determine if the damage sustained by the receiving waters can be reversed by implementing modern-day stormwater controls. As part of this study, Villanova is using the Richard Pathway method to classify the flashiness of the streams at each monitoring site. This will give an indication of stream health and the impact of the mall on Chrome Run.

D-66: Impact of Morphology on GSI Infiltration
Author: Huggins, Conner; Smith, Virginia
Advisor: Dr. Virginia Smith

Green Stormwater Infrastructure (GSI) is an increasingly important solution for hydrologic and water quality control for municipalities and watershed planners, and designers. While the effectiveness of these systems in addressing event-based hydrologic occurrences has been widely studied, little is known about the long-term sustainability of GSI and less about the how morphological changes impact the performance of such systems over an extended period, which could potentially impact the success of the GSI. This work is part of a study that utilizes a quasi-3D morphodynamic model to predict long term morphological changes in a rain garden and relates these changes to the performance of the rain garden using a series of field measurements of infiltration rates, flow, and soil properties within the GSI. For this study several tests were done on soil samples from operational and failed sites in Fishtown, PA, that are part of the I-95 rehabilitation project, to determine the sites' soil density, water content, organic content, plastic limit, liquid limit, etc. This information was then evaluated against the GSI specification and model outputs to help determine their morphological and compositional changes. The model used is a continuous quasi-3D morphodynamic model that was created in the International River Interface Cooperative (iRIC) software using high resolution LiDAR elevation data and a continuous record of storm water inflow data. A spatial analysis of morphological changes is then performed by combining the model results with post-construction in-situ infiltration test results to determine a relationship between the morphological changes and infiltration rates over time. The findings of this study are important to understanding how potential changes in soil characteristics due to GSI morphology impact the GSI sustainability. More importantly, this study presents an important starting point for quantitatively predicting lifespan and maintenance requirements for GSI. The study will also shed light on the role of sediment inflow on the overall sustainability of GSI and how GSI can be optimally designed to reduce the impact of morphological changes on performance.

D-67: Effectiveness of Solarization Treatment as an Intervention Strategy to Reduce Antibiotic Resistant Bacteria in Cattle Manure Stockpiles
Author: Bridget, Gile; Mware, Noelle; Li, Xu
Advisor: Dr. Xu Li

In the livestock industry, antibiotics are administered to animals to prevent disease and promote growth. Antibiotics that persist in sublethal concentrations can select for antibiotic resistance genes, which can be transported via livestock wastes into soil, crops, and water. Contamination of environmental systems leads to a greater occurrence of antibiotic resistance in vivo, which threatens the effectiveness of antibiotics in treating bacterial infections in humans. This experiment examined the effectiveness of solarization as a physical treatment for reducing antibiotic resistant bacteria in cattle manure stockpiles. The solarization technique utilizes a plastic film to trap heat and moisture to facilitate lethal temperatures throughout a greater portion of the stockpile relative to uncovered conditions. In this study, cross-sectional temperature profiles and bacterial populations were compared between two stockpiles, one control and one with solarization treatment applied. Using EPA time-temperature composting regulations, preliminary results suggest that solarization expands the zone meeting treatment requirements for both Class A and Class B applications. Additionally, solarization treatment resulted in higher relative humidity in the outermost zone of the treatment pile compared to the control. As future work builds confidence in temperature and bacterial patterns, this research will aid in assessing the capabilities of solarization as a tool to limit the transport of antibiotic resistant bacteria without relying on environmentally hazardous chemicals.

Computing Science

D-68: Mitigating DNS Information Leakage in Tor with Distributed Hash Tables
Author: Balog, Paul
Advisor: Dr. Henry Carter (In collaboration with the University of Nebraska- Lincoln)

The Domain Name System (DNS) is a unifying component of the modern Internet that makes accessing numerically addressed services memorable for human users. However, it has become a choke point in user access that is being exploited for data gathering and Internet censorship. Recent regulation changes in the United States allow ISPs to more liberally share and monetize DNS data, increasing their incentive to aggressively profile user activity. This massive amount of data collection can be performed easily at a recursive DNS resolver, and represents a major privacy failure in the current Internet architecture. This mass collection of DNS requests can be used to deanonymize users. Although Tor provides strong anonymity and privacy by mixing their traffic with other Tor users, effectively decoupling users from their online activity, recent work has shown that an adversary who can observe an encrypted stream entering Tor and some fraction of DNS requests emerging from Tor can use this DNS information to strengthen website fingerprinting attacks that de-anonymize user activity. In this work, we seek to strengthen Tor by constructing a novel extension to the way domains are resolved by exit relays. Rather than having the exit relay perform resolution for all DNS requests from an individual circuit, we use a distributed hash table (DHT) to designate different exit relays within Tor as responsible for resolving domains that hash to their identifiers. When combined with DNS caching, this ensures that DNS requests are fulfilled from a cached record as frequently as possible, minimizing the number of observable DNS resolution requests leaving the Tor network. We have evaluated the reduction of outgoing DNS requests using TorPS, a program that creates virtual

circuits using past Tor consensuses. We simulated 10,000 clients accessing Facebook, Gmail, Google Calendar/Docs/Chat and various search engines using Tor's consensus of June 2017 over one month. Our experiments showed that 5% of total connections would require an outgoing DNS request. After applying our extension, <0.1% of total connections would require an outgoing DNS request, a fifty-fold reduction. We make the following contributions: First, while DHTs have been proposed in next-generation DNS systems for efficiency and robustness to failure, we are the first to use their distributed nature for maintaining privacy. Second, our proposed extension to the Tor protocol allows DNS queries to be answered internally through caching as frequently as possible. In addition, our rotating hash scheme ensures that an adversary attempting to collect DNS requests for a particular domain must do so from a variety of observation points, as a stationary observer will have an inconsistent view of DNS requests. In combination, these techniques strengthen Tor against website fingerprinting attacks while requiring minimal changes to the existing relay design. Finally, we empirically evaluate the security improvement achieved by distributing DNS resolution using DHTs. Our future work will evaluate the performance overhead of this extension. Using shadow, a program that creates and simulates a virtual Tor network, we will examine the additional latency from the extension.

Economics

D-69: The CAPM, National Stock Market Betas, and Macroeconomic Covariates: A Global Analysis
Author: Curran, Michael; Velic, Adnan
Advisor: Dr. Michael Curran

Using global data on aggregate stock market prices, this paper finds that the standard capital asset pricing model (CAPM) fares much better than suggested in the literature. At shorter time horizons, our results also show that the positive risk-reward relation can collapse during times of high volatility. Compared to advanced and emerging markets, we retrieve evidence of lower systematic risks across frontier stock market portfolios. We find that countries characterized by higher levels of financial and trade openness, exchange rate volatility, and larger economic size are exposed to higher systematic covariances with the world stock market. Conversely, we obtain evidence of an inverse link between international reserves and systematic risks in national equity.

Environmental Science

D-70: The Effects of Saltwater Intrusion on Freshwater Tidal Marshes along the Delaware River
Author: Willis, Lloyd
Advisor: Dr. Kabindra Shakya

My summer project focuses on the effects of saltwater intrusion on freshwater tidal marshes. Even though I am looking at general effects of saltwater intrusion on freshwater tidal marshes, my research focuses on these marshes along the Delaware River. My research considers what causes saltwater to intrude on freshwater marshes, one aspect being sea level rise, what some specific effects are, specifically effects on the carbon cycle, and why this entire process is important. In addition, I will be using a program called SLAMM to help demonstrate the effects of saltwater intrusion by showing predictions of what could potentially happen to the surrounding area many years from now. For my research, I used SLAMM to show changes in sea level rise and am working on showing changes in

salinity in an area located on the Delaware River over a course of around 100 years. From my outside research, the consensus is that saltwater intrusion does have an effect on freshwater tidal marshes and through my work with SLAMM I plan to show and demonstrate this concept.

Geography and the Environment

D-71: Villanova Wetland Greenhouse Gas Flux
Author: Ruscheinski, Keegan; Weston, Nathaniel
Advisor: Dr. Nathaniel B. Weston

Wetlands are beneficial ecosystems on a global and local scale. They provide various ecosystem services that help regulate the earth's climate. However, wetlands have also proven to have a negative impact on the environment, particularly on the atmosphere. They release enormous amounts of methane due to methanogenesis, estimated at about 15-45% of total methane emissions. The goal of this project is to study the intake and output of various greenhouse gases within the wetland ecosystem and how that may contribute to overall climate change. In order to study a local example, the Villanova West Campus wetland was used to record the greenhouse gas emissions coming from different areas of the wetland. The study was done spatially and temporally, using floating chambers over water to capture released greenhouse gases as well as static chambers over biomass to capture sequestered gases at different points of time during the summer. From the data discovered, one can conclude that wetlands do in fact have an impact on the atmospheric gas conditions due to their ability to interact with various types of greenhouse gases.

Mathematics

D-72: Asymetric Demographic Models with a Mate-Finding Allee Effect
Author: Anderson, Elizabeth; Ott, Jared; Terrett, Gwyneth
Advisor: Dr. Daniel Maxin

In a two-sex demographic model, the most challenging mathematical components are the couple-formation functions. These functions link the number of pairs with the number of available singles. They are usually not detailed enough to include important aspects of social behavior such as: motivation for pairing which may be gender specific, scarcity or abundance of the opposite gender or social/ economic factors. In this research we analyze several two-sex models to better describe asymmetric demographic situations. In particular we focus on mate-finding Allee effect which models the difficulty of pairing at low population densities and investigate whether this effect is sensitive to changes in sex ratios and/or overall female/male densities. We also compute the Allee threshold which separates population extinction from persistence and test these results against real demographic data from both animal and human populations.

D-73: Modeling the Spread of a Black Rot Epidemic on a Vineyard
Author: McKean, Jessica
Advisor: Dr. Peter Muller

Black rot, caused by the fungus Guignardia Bidwellii, is one of the most serious causes of crop loss of cultivated grapes in eastern United States. The goal of this research is to develop an improved, simpler model for the spread of the black rot fungus among grape vines. This work extends general population-dynamic models within the field of plant epidemiology to account for the back rot dynamics found in more complex models. We add more stages to the progression of the disease to account for methods of treatment and the natural population dynamics of grape vines and the black rot fungus. In addition, model parameters were derived from data when available. The model is further extended and analyzed numerically for a theoretical multi-season scenario.

D-74: Representation Theory of Algebraic Monoids and their Hecke Algebras
Author: Vetter, Alexander; Marx-Kuo, Jared; McDonald, Vaughan, O'Brien, John
Advisor: Dr. Benjamin Brubaker (University of Minnesota School of Mathematics)

Behind every great reductive group lies a great reductive monoid. Indeed, GL(n) lies inside M(n), the monoid of n-by-n matrices over a field K. The representation theory of finite groups is well studied; however, the representation theory of finite monoids is not. Inside of every monoid, is a group of units. We use the representation theory of the group of units in order to understand the representations of monoids. We extend well-known results for groups to analogous results for monoids. In particular, we prove an analog of the Borel-Matsumoto theorem and Froebnius Reciprocity for subgroups of the group of units in a monoid using Godelle's definition of convolution for monoids. The rook monoid is a well-studied monoid. The rook monoid is realized as n-by-n matrices of ones and zeros such that each row and column has at most a single nonzero entry. We introduce a new description of the symplectic rook monoid and provide an embedding of it into the rook monoid. This is apparent as the symplectic rook monoid naturally forms a submonoid of the rook monoid. We then investigate the specific nature of the symplectic rook monoid. The irreducible representations are indexed by partitions of at most n, and pairs of partitions whose sum is exactly n. We use this to examine its character table and branching rules for decomposing its irreducible representations when restricting to the group of units. Using results from Solomon about the structure of the character table of the rook monoid, we determine a new way of producing the character table for the Iwahori-Hecke algebra of the rook monoid. In the spirit of Solomon and utilizing techniques from Geck and Pfeiffer, we provide a description of the character table of the symplectic rook monoid. We extend this to the Iwahori-Hecke algebra of the symplectic rook monoid.

Mechanical Engineering

D-75: Improving the user interface of data center modeling software
Author: Etim, Anthony
Advisor: Dr. Aaron Wemhoff

Data centers around the world require a lot of energy because they house the servers used in e-commerce, online banking, and high-performance computing. Thus, energy efficient methods to use power from the electric grid are sought due to the large energy consumption wasted in power losses

and cooling. The goal of the Energy-Smart Electronic Systems (ES2) research center is improving data center energy efficiency. The Villanova Thermodynamic Analysis of Systems (VTAS), a software tool developed in ES2, calculates the power consumption (including losses) in data center power and cooling systems. This tool allows a user to improve data center energy efficiency by comparing different cooling and power delivery strategies. One issue with VTAS is its lack of user base due to its largely text-driven input requirements. Therefore, this project enables VTAS to become more user friendly in two ways: first, by developing an electrical system graphical user interface (GUI) layout based on the existing layout capability for the cooling system; and second, to explore approaches to improve the deficiencies in the current layout capability. Addressing these areas will greatly improve the GUI, making VTAS more likely to be adopted for energy efficiency calculations and design in the data center industry.

D-76: Autonomous Quadrotors and Lower-Body Exoskeleton
Author: Pedersen, James; Palmese, Ella; Bauman, Joseph; Kennedy, Nicholas
Advisor: Dr. Hashem Ashrafiuon

The Center for Non-Linear Dynamics and Control Lab (CENDAC) was tasked with completing two projects. The first project was to design, assemble, evaluate, and improve upon multiple quadrotors. The purpose of the quadrotors is to provide surveillance along with communication with other autonomous vehicles. The main focus was to make the quadrotors lighter, more agile, and increase their overall performance. To accomplish this task, 3-D printing and coding were utilized, along with obtaining new components to maximize the performance. The second project was focused on completing a lower-body exoskeleton. The exoskeleton consisted of six motors which were to act simultaneously with the final goal of leg rehabilitation. To achieve this, both legs and motors were first attached to the exoskeleton and its range of mobility was tested. After it was assembled, a Raspberry Pi and several Arduinos were used to control the movements of each motor using Python and C. As a group we successfully improved the Quadrotors and the Exoskeleton in CENDAC Lab.

D-77: SeaCat: Autonomous Surface Vehicle
Author: Watkins, Reed
Advisor: Dr. C. Nataraj

The SeaCat is a twin hulled autonomous robotic boat designed and built by Villanova students. The configuration currently being worked on will be used in the 12th annual RoboBoat competition in South Daytona, Florida. The SeaCat will ultimately be capable of performing marine based tasks such as navigation through buoys and self-docking. After not having competed in the 2016-2018 competitions, Villanova hopes to return successfully in 2019.

D-78: Developing Ultra-Light Silver Nanowire Aerogel for Enhancing Energy Storage Materials
Author: Zhang, Lin; Deb, Aarya; Xiaosong, Liu; Feng, Gang
Advisor: Dr. Gang Feng

Thermal management has become one of the particularly attractive fields because it bridges the gap between continuous energy generation and consumption. Phase change materials (PCMs) like Paraffin wax (PW) have numerous potential applications in the field of electronics and energy for thermal energy storage and management due to their high latent heat. However, the low thermal conductivity of PCMs hinders their efficiency. Here, we propose to enhance the thermal efficiency of PCMs by

embedding highly-thermal-conductive Silver Nanowire (AgNW) aerogel into PCMs. Such 3D superstructures as supporting materials would have an essential effect on the thermal conducting performance of PW composites. This research is intended to measure and analyze the thermal properties of PW composites filled with AgNW aerogel. Here, we have fabricated ultralow-density AgNW aerogels with a well-defined shape. The morphological and microstructural characteristics of AgNW aerogels are investigated in detail. AgNW aerogel/PW composites will be prepared and subjected to a series of thermal measurements including the melting temperature, thermal capacity, latent heat and thermal conductivity. Based on present work, AgNW aerogels prepared in this study showcase promising applications for the thermal energy storage. The valuable information gained from this research project could help us to predict the interaction between PCMs and nanomaterials, providing insights for designing PCMs with high-efficiency.

Nursing

D-79: Lost in Transition: Promoting Parkinson's Disease Patient Medication Safety.
Author: Doyle, Addison; Galvin, Meghan; Ellis, Diane; Hickey, Shelly
Advisor: Dr. Diane Ellis

Over one million people in the United States (US) suffer from Parkinson's disease (PD), a chronic, degenerative neurological disorder, with approximately 60,000 new cases identified in the US each year. PD is the second most common neurodegenerative disorder among adults, with only dementia being more common. It is well known that patients who experience a care transition, such as a hospitalization are vulnerable for poor outcomes. PD patients are at particularly high risk when admitted as prior research indicates hospitalized PD patients often do not receive their medications on time, experience an abrupt stoppage, or have medications omitted. As a result, 61% of PD patients who experience an interruption in medication timing or omissions suffer poor outcomes. Evidence indicates nurses caring for PD patients are unaware of the importance of timely medication administration. The purpose of this study is to increase knowledge among undergraduate nursing faculty (n=9) and students (n=97) to determine the effects of a lab simulation on medication administration for hospitalized PD patients. The simulation consists of a PD patient scenario, medication administration challenges and varying code responses. Study participants first take a pre-test, experience the simulation, and conclude with a debriefing of the scenario and post-test. Final study results are pending, however, data findings are trending toward an increase in nursing faculty and student understanding of the importance of timely and accurate medication administration among hospitalized PD patients. Results further indicate that faculty and students are able to better identify the results of omitted PD meds versus initiating a rapids response following participation in the simulation.

D-80: Effective interventions to implement evidence-based practice (EBP) in acute care nursing: Systematic review update
Author: Harvey, Stephanie SN; Yost, Jennifer PhD, RN
Advisor: Dr. Amy McKeever

Evidence based practice (EBP) is at the center of the nursing profession. Therefore, effective interventions to implement EBP need to be identified. Although a systematic review to synthesize

what is known about such interventions was previously done (2015), there is a need to update this review to fill gaps and reflect current knowledge. A systematic review is currently underway. A comprehensive search, including electronic databases and printed journals, was done to identify relevant pool of citations (February 2018). The title and abstract of citations identified were screened by two people using questions to determine if they met relevance criteria: 1) written in English, 2) is a systematic review, a mixed methods study, or quantitative study, 3) conducted in an acute care setting, and 4) involved nurses. The articles that met this criteria (answered "yes" or "unsure") will now undergo screening of the entire full-text by two people to determine if the article, in addition to the title and abstract criteria, describes an intervention for implementing EBP and report outcomes related to change in a) nurses' knowledge or skills for research use, b) nurses' research use (behaviour), or c) patient outcomes as a result of nurses (or nurses as part of the healthcare team) research use. Studies that meet the full-text screening criteria will be critically appraised and synthesized, either narratively or using meta-analysis to combine the data of similar studies. The search identified 22,088 citations. The title and abstract screening of the 22,088 citations is now complete. 1,954 citations met the inclusion criteria and will now move on to full-text screening. This synthesis can inform decisions about what interventions can improve EBP among nursing to improve patient care and patient outcomes.

E-81: Adolescent Health Risk Behaviors and the Influence of Parental Actions
Author: Munter, Lauren
Advisor: Dr. Elizabeth Dowdell

Background/Purpose: The health of adolescents and young adults is critically linked to health-related behaviors. Identifying parental risk behaviors that influence adolescent behavior may help to identify at risk youth. This study examined the relationship between parental health risk behaviors compared to their adolescent. A secondary analysis of four waves of data (1994 to 2008) from the National Longitudinal Study of Adolescent Health (Add Health) was undertaken for this study with a sample of 16, 388 adolescents and parents who participated in the surveys. Findings from the Parent Survey and Wave I of the Add Health showed that parental alcohol use and smoking behaviors influenced adolescent consumption. The influence of parental behaviors was found across all four waves of data with adolescents, and as young adults, reporting participation in health risk behavior. The more alcohol the parent reported drinking the higher the use reported by the adolescent ($p = .0001$), including binge drinking (5+ drinks in a day) where adolescent bingeing increased as parental binge habits increase ($p = .0001$). A similar trend was found in cigarette smoking with only 16.8% smoking cigarettes regularly when a parent does not compared to the 27.8% whose parent also smokes ($p = .0001$). Parents were more likely to under-report adolescent smoking, saying their adolescent does not smoke, when (51.8%) of adolescents who reported that they did had parents who said they did not, suggesting that parents are unaware of their adolescent's risk behaviors ($p = .001$).Parental behavior influences adolescent risk taking behavior as well as behaviors undertaken as young adults. Interventions combined with collaborations between healthcare professionals and parents are needed to identify teens who are exhibiting risk behavior. Professionals across multiple disciplines are committed to promoting healthy behaviors in individuals throughout the lifespan.

E-82: What does it mean to have a peer who self injures: Examining the risk taking behaviors in high school students
Author: Noel, Julia
Advisor: Dr. Elizabeth Dowdell

Self-harm is defined as "the direct and deliberate destruction of one's own body tissue without suicidal intent" such as cutting or burning oneself (Nock & Prinstein, 2005). Self-harm is viewed as a symptom of emotional distress or stress and is an unhealthy way to cope with emotional pain, intense anger and or frustration. The self-harming action typically brings a momentary sense of calm or a sense of relief from stress, followed by a sense of guilt and shame, which bring the return of the painful emotions. Among adolescents self-harm has been on the rise with an estimated 17.2% engaging in self-harm, and girls most often reporting higher rates of self-harm than boys (Monto, McRee, & Deryck, 2018). A secondary analysis from a 2012 data set containing quantitative data from 5,411 high school students found that 72% (n=3,895) reported knowing someone who has cut themselves or tried to harm themselves in some other way. The sample contained 80.3% of girls and 61.2% of boys and descriptive statistics were used in analysis. Students who reported knowing a friend who self harms had higher rates of health risk behaviors. Reports of aggression were high with having been bullied (34.6% vs 25.1%; p= .000) and cyberbullied (20.1% vs 6.8%; p= .000) as well as knowing others who have been cyberbullied (58.8% vs 27.3%; p=.000). They were more likely to smoke cigarettes (17.2% vs 6.7%, p= .000), drink alcohol (57.6% vs 39.0%, p= .000), and use drugs (24.4% vs 8.8%; p= .000). Twice as many had sent (23.6% vs 12.9%; p= .000) and received sexts (34.7% vs 19.9%; p= .000), as well as have friends who sent or received a sexting message (59.7% vs 32.5%; p= .000). It is very possible that these friends who are participating in these health risk behaviors may be the ones who are self harming. Findings from this study suggest that high school students who know someone who self injures have additional online and health risk taking behaviors. Nurses and other professionals are in key roles to screen, identify, and assess risk-taking behaviors in adolescents, particularly school nurses. Focused nursing interventions and educational programs that emphasize screening, prevention, risk reduction and safety in addition to long-term impact are imperative.

E-83: Determining Readiness for Discharge from Skilled Home Health Services
Author: O'Connor, Melissa; Donnelly, Erin SN; Kenny, Maeve SN
Advisor: Dr. Melissa O'Connor

According to the Medicare Payment Advisory Commission, in 2015, 3.5 million Medicare beneficiaries utilized home health care services, which include skilled nursing care, physical therapy, occupational therapy, speech therapy, and medical social work. The cost of these services provided by the 12,300 or more agencies totaled $18.1 billion (MedPAC, 2017). It is important that an investment of this size be functioning efficiently. However, prior research indicates that this may not be the case. In fact, we are seeing premature discharges and adverse patient outcomes. Home health lengths of stay of less than 21 days, compared to a home health length of stay of 42 days or more, increased the need for hospitalization and decreased the time to hospitalization and death within 90 days following discharge from skilled home health services (O'Connor et. al., 2015). These findings suggest that vulnerable older adults who are discharged from skilled home health prematurely may be more likely to experience poor outcomes (hospitalization and death). Furthermore, there exists a gap in the literature and, therefore, our knowledge related to discharge readiness from skilled home health services. This study aims to fill the gap in knowledge related to discharge readiness by interviewing home health patients (N = 18) and family caregivers (N = 5). Their experiences offer clinicians a better understanding of the patient perspective in relation to discharge from home health. Interviews were

conducted by members of the research team. The qualitative content was analyzed, and themes emerged. Patients and family caregivers consistently mentioned factors affecting their readiness for discharge that could be categorized into one or more of the 9 identified themes: 1) connection to community resources/support, 2) addressing safety needs of the home environment, 3) functional status, 4) presence of a caregiver, 5) support of the caregiver, 6) adherence of the prescribed regimen, 7) care coordination, 8) status of condition (s), and 9) self-care ability. With the results produced from this study, a more comprehensive understanding of the factors most important in determining readiness for discharge from skilled home health services exists. Decision support can assist health care providers to provide clinically appropriate care and provide much needed direction in determining readiness for discharge from skilled home health. Therefore, the next steps involve using this information to develop an evidence-based tool that can be used by clinicians to accurately assess readiness for discharge.

E-84: Compassion Satisfaction & Burnout in Relation to Patient Deaths among Pediatric Intensive Care Nurses

Author: Richardson, Kyle; Greenle MacKenzie, Meredith
Advisor: Dr. Meredith MacKenzie Greenle

The death of a patient can be devastating for a nurse and the entire nursing unit. The intensity of the grief may be heightened when the patient is a child. Repeated exposure to patient death can create professional and personal stress that could lead to burnout, secondary trauma and low compassion satisfaction. In order to better identify the impact of patient death on compassion satisfaction, burnout and secondary trauma among pediatric intensive care nurses, I propose to examine the following specific aims: 1) Examine the relationship between experiencing the death of a pediatric patient and compassion satisfaction, burnout and secondary trauma; 2) Determine whether a relationship between patient death and compassion satisfaction and burnout is moderated by nurse characteristics (age, gender, certification, years of experience, educational attainment, spirituality) and hours worked per week. This was a descriptive, comparative study. A JotForm survey distributed via email and LinkedIn groups to pediatric and neonatal intensive care nurses. A $5 gift card was offered as an incentive for completion. The survey contained demographic questions, a question about codes, rapid responses and patient death in the last month, and the Professional Quality of Life Scale, which has 3 subscales measuring compassion satisfaction, burnout and secondary trauma. Multivariate linear regression modeling was used to identify correlates of compassion satisfaction, burnout and secondary trauma. There were 65 respondents, the majority of whom (94%) were female, aged 41-45, with a bachelor's degree (71%). Thirty-seven percent identified as religious and practicing. No significant relationship was found between the number of codes or patient deaths experienced in the last month and compassion satisfaction, burnout or secondary trauma. Higher educational attainment was significantly correlated with lower compassion satisfaction (= 2.56, $p < 0.01$), even when controlling for burnout (= -0.94, $p < 0.001$), and secondary trauma (= 0.26, $p < 0.05$). Similarly, having a higher educational degree was correlated to higher levels of burnout (= 2.44, $p < 0.005$), again even when controlling for compassion satisfaction (= -0.57, $p < 0.001$) and secondary trauma (= 0.39, $p < 0.001$). Lastly, significant correlates of secondary trauma include age (= -0.56, $p < 0.005$), burnout (= 0.83, $p < 0.001$) and compassion satisfaction (= 0.36, $p < 0.05$) with greater age, higher burnout scores and lower compassion satisfaction linked to greater secondary trauma. Contrary to our hypothesis, we found no relationship between the number of codes, rapid responses or patient deaths experienced in the last month and the outcomes of compassion satisfaction, burnout and secondary trauma. We were surprised to find that greater educational attainment was negatively correlated with compassion

satisfaction and positively correlated with burnout. Further research is needed to both evaluate the impact of educational attainment on nurse outcomes. In addition, examination of possible differences between adult and pediatric intensive care nurses in relationship to compassion satisfaction, burnout and secondary trauma is needed.

E-85: Unintentional Pediatric Gun Deaths, Accredited Nursing Schools, and State Legislation: A Secondary Analysis of Safety and Prevention
Author: Treacy, Patrick
Advisor: Dr. Elizabeth Dowdell

Background: Gun injury is a leading cause of death among U.S. children and adolescents. When children are fatally injured by guns, most often the location is a home and the shooter is a family member. In the U.S., each state has its own laws regarding guns, but only 27 out of 50 states have child access prevention (CAP) laws that deter negligent storage of firearms.
Purpose: The purpose of this study was to examine the relationship between CCNE accredited nursing schools and existing state legislation regarding safe storage of firearms against the rate of fatalities of children due to unintentional firearm injury from the years 1999-2016.
Method: Secondary analysis of data was from the CDC's Web-based Injury Statistics Query and Reporting System, Giffords Law Center, web hosted legislation from each state, and the American Association of Colleges of Nursing's accreditation directory.
Sample: A total of 27 states and 1,425 reported child gun fatalities were included. States were excluded if gun incidents were below 20, or had a total child population of over 100,000,000. States were sorted into regions: North East, Midwest, South, and West.
Data Analysis: State legislation was analyzed using character count to quantify the complexity and comprehensiveness of storage laws. Regional legislation count was then compared to the number of CCNE accredited nursing schools per state and the rate of fatality.
Results: Regions with high character count legislation had lower fatality rates ($p < 0.05$), regions with more CCNE accredited nursing schools had higher character count of legislation ($p < 0.01$), and regions with more CCNE accredited nursing schools had lower fatality rates ($p < 0.05$).
Conclusion/Implications: Findings suggest that CCNE accredited nursing schools may directly impact legislation that promotes gun safety and health promotion for children. Additionally, safe storage laws and CAP laws may directly reduce the number of accidental deaths of children involving a firearm. Nurses are one of the first lines of defense when it comes to home safety and may influence policy in states that have less complex legislation or no regulation of firearms in households with children."

E-86: Stem Cell Therapy for the Treatment of Type 1 Diabetes Mellitus
Author: Danner, Alyssa
Advisor: Dr. Melissa O'Connor

Stem cell therapy poses a promising treatment for type 1 diabetes mellitus (T1DM). T1DM is a chronic, life-threatening disease characterized by an autoimmune destruction of insulin-producing pancreatic β cells that are necessary to regulate blood glucose. Therefore, people with T1DM experience high glycemic variability. High glycemic variability can lead to poor blood circulation, heart disease, stroke, kidney failure, and premature death. There are 1.25 million Americans living with T1DM, but 5 million are expected by 2050. In 2013, the United States spent $101.4 billion on T1DM with increased costs expected as this population grows. Current insulin delivery systems consist of many painful injections and constant monitoring to effectively control T1DM. Although insulin

delivery systems are available, they do not maintain blood glucose levels for an extended period of time. These systems are unable to mimic normal insulin secretion from pancreatic β cells. The only potential conclusive cure for this disease is providing a renewable source of β cells that are able to assess blood glucose levels and secrete insulin. Researchers have recently discovered several different approaches using stem cells to treat and possibly cure T1DM. Leading researchers in stem cell therapy for T1DM, such as ViaCyte, Inc. and Dr. Douglas Melton, discovered new β cells using human embryonic stem cells. However, clinical implementation has been challenging due to the autoimmune nature of T1DM. The purpose of this literature review was to explore the most effective stem cell therapies in the developmental stage for treating T1DM. The CINAHL and PubMed databases were searched for relevant studies published between 2006 and 2018 using the search terms "type 1 diabetes", "stem cell therapy", and "pancreatic beta cell", generating 11 studies eligible for inclusion. The most promising solution for clinical application is an encapsulation device that protects the newly implanted pancreatic cells β from immune system attack. The discovery of a renewable source of β cells prompted many researchers in this field to create an encapsulation device. Due to the challenges that encapsulation devices present, most devices, aside from ViaCyte, are currently in development or pre-clinical research. ViaCyte, Inc.'s device, the PEC-Encap, is the leading stem cell therapy for T1DM. ViaCyte's most recent results suggest that the PEC-Encap is safe and tolerable while protecting cells from immune attack. ViaCyte's results are promising, but device engraftment was not as robust as ViaCyte had hoped. When engraftment was successful the PEC-Encap was able to secrete insulin in a glucose-dependent manner. Additional research is required to improve engraftment and reliability of the encapsulation device."

Pharmacology and Cancer Biology

E-87: Rapastinel as a Non-Opioid Treatment for Opioid Dependence
Author: Ferrante, Julia; Lamichhane, Nidesh; Kuhn, Cynthia
Advisor: Dr. Cynthia Kuhn (Duke University)

An increasing number of opioid overdose deaths have resulted from the rising availability of both prescription and nonprescription opioids. Pharmacotherapies, such as buprenorphine and methadone, have been developed to treat those dependent on opioids. However, these current pharmacotherapies are opioid agonists or partial agonists, which cause the patient to remain in an opioid-dependent state throughout treatment. As a result, the patient experiences more withdrawal symptoms and has a higher risk of relapse. These limitations show a clear need for a non-opioid pharmacotherapy. To test non-opioid pharmacotherapies, we examined drugs that target the NMDA receptor. The NMDA receptor is associated with impulsive drug taking behavior and is involved in the maintenance of opioid dependence. By regulating the NMDA receptor, it may be possible to manage aspects of opioid dependence. Ketamine, an NMDA antagonist, has potential as treatment, but its use is restricted due to severe dissociative side effects. Rapastinel, a novel antidepressant, acts as a partial agonist of an allosteric site of the glycine site of the NMDA receptor complex. Rapastinel has not been shown to produce any negative side effects during treatment. We tested the efficacy of ketamine (1 mg/kg, IP) and rapastinel (5 mg/kg, IV) as treatment in opioid-dependent adolescent rats (N= 50). Drug efficacy was measured by the reduction of opioid withdrawal symptoms post-treatment. By testing non-opioid pharmacotherapies, we hope to develop more sustainable and effective treatment options.

Physics

E-88: X-Ray Imaging of the Jet From the Supermassive Black Hole M87
Author: Anczarski, Jadyn; Neilsen, Joseph
Advisor: Dr. Joseph Neilsen

The Supermassive black hole, M87, has long been a target of interest for the study of black hole physics and relativistic jets across the electromagnetic spectrum. This is particularly true for the Event Horizon Telescope (EHT), a worldwide network of radio telescopes with enough resolution to image the black hole's event horizon. In April 2017, the EHT and many ground- and space-based observatories undertook a campaign to study nearby supermassive black holes, including M87, at many wavelengths. As part of this campaign, we observed M87 with the Chandra X-ray Observatory for a total of 26.24 ks over two exposures. These observations enabled us to study the black hole and relativistic jet in M87 at high energy. We created images of M87 and spectra of the nucleus, which includes emission from both the core and a bright knot in the jet called HST-1. We also created a deconvolved image to explore the relative intensity of the core and HST-1. Our analysis of the deconvolved image suggests that HST-1 was significantly fainter than the core. We found no evidence of strong variability in the X-ray brightness during our observation, but compared to the historically recorded spectra of the core, we discovered a slight decrease in the photon index (Γ=2.11+0.08/-0.09, compared to a typical value of Γ = 2.25+0.10/-0.10 in the recent past). M87 was also fainter than in recent observations (L_x ~ 1.25 x 10^41 erg/s). Given HST-1's history of variations and recent trends indicating a fading HST-1, we suggest that the lower photon index may be due to a fainter HST-1 knot.

E-89: X-ray Spectroscopy of the Black Hole GRS 1915+105
Author: Aramburu Sanchez, Pablo; Neilson, Joey
Advisor: Dr. Joey Neilsen

The black hole binary GRS 1915+105 is well known for its accretion and ejection processes, presenting a strong variability in its continuum. We report on two observations of GRS 1915+105 made by the X-ray telescope NuSTAR in June and August 2017. We performed analyses of the time averaged spectra and of the time resolved spectra, dividing our observation into intervals with high and low count rates respectively. We report a disk temperature of {1.73}_{-0.002}^{+0.003} keV and {2.04}_{-0.01}^{+0.07} keV for the first and second observations respectively. During our second observation, which exhibits strong variability, we found a disk temperature of {2.198}_{-0.001}^{+0.005} keV at high flux, and {1.769}_{-0.007}^{+0.006} keV at low flux. [Disk flux changes are primarily responsible for the variability]. We found little to no accretion disk emission during the low count rate intervals of either observation. We also found a significant accretion disk wind in both spectra, which was stronger at low flux. The equivalent width of the iron absorption line, which we found at 7.05 keV, was of 8.69 eV for the high flux in the first observation and 10.47 eV at the low flux. For the second observation we found an equivalent width of 26.99 eV at the high flux, and 32.81 eV at the bottom of the light curve. We discuss these results in the context of mechanisms for wind variability and accretion disk instabilities, as well as compare these results with the classical results for GRS 1915+105.

E-90: Developing an Iterated Cumulative Sum of Squares Change-point Analysis to Probe the Source of Blip Glitches in LIGO Data

Author: Caesar, Matthew
Advisor: Dr. Amber Stuver

This work was focused on creating and characterizing a new data analysis method for the LIGO scientific collaboration. Blip glitches are a common and harmful noise source for both the Livingston and Hanford LIGO detectors. The use of this new method aims to find the source of blip glitches by finding correlations between times around when blip glitches are known to have happened in LIGO strain data and when any of the thousands of auxiliary data channels show significant changes in variance. The cumulative sum of squares method (CSS) that was created over the summer works by finding changes in variance in a signal that are greater than a given threshold. After the initial frame of the program was created, it was put through many different tests to gain a good idea for how it works and behaves under different conditions. Both real and simulated signals were analysed using the CSS method to refine and make it more efficient. The end result described the efficiency of the CSS method at finding random changes in variance of gaussian noise. A three dimensional plot is used to visualize the efficiency of the program as a function of the length of the variance change and its magnitude.

E-91: Gravitational Wave Background and Vetoes

Author: Dean, Ray
Advisor: Dr. Amber Stuver

My objective this summer was to assist my professor and her collaboration, the Laser Interferometer Gravitational Wave Observatory (LIGO) in determining the potential for different Glitch Classes to be used as Vetoes. Gravitational Waves were theorized by Albert Einstein, to be produced by catastrophic astronomical phenomenon thousands of light years away from Earth, such as binary black hole mergers and supernovas. Even such a powerful event, at such a distance, only causes minute changes to Space-Time, the medium in which these waves travel. As such LIGO's Gravitational Wave Detectors are massive laser interferometers that measure the length of the resonance chambers in which they reside, to an accuracy of 1/10,000th the diameter of a proton. Unfortunately, with such precision comes a sensitivity to other non-astronomical noise sources like earthquakes, electrical malfunctions, etc.These sources cause glitches that are identified by comparing data of both detectors (Hanford, Washington and Livingston, Louisiana), and delegitimizing any potential waves that either traveled to fast or too slow to be real. Previous detections have confirmed Einstein's prediction that these waves travel at the speed of light, enabling LIGO to make these conclusions. Based on these conclusions, glitches are able to be identified based on their waveform. Gravity Spy, citizen science project that trains and utilizes volunteers to categorize these glitches into classes, in the hopes that the source of each class can be more easily identified. My goal this summer was to assess the potential of each class to be simply ignored. Each small glitch by itself, has little to no effect on any other data analysis methods. However, over time, many of these glitches build up and negatively affect the confidence of any potential gravitational wave detection. Utilizing, LIGO's Veto Evaluation Tool I was able to determine which classes at LIGO's Hanford Observatory would beneficially impact the data if they were simply removed. I did this analysis for glitch detection methods that could benefit from these Vetoes, as well as Gravitational Wave detection methods. If we are able to utilized these potential vetoes, we can increase the LIGO detection confidence significantly. Each Gravitational Wave detection provides important information concerning both the source of the wave and the

nature of experimental gravitational physics. With more consistent detections, LIGO can provide a near constant and extremely accurate source of phenomenon for the rest of the Astronomy Community.

E-92: Characterization and Analysis of Gravity Spy Glitch Classes
Author: La Manna, Nicholas; Stuver
Advisor: Dr. Amber Stuver

Detecting gravitational waves require the most sensitive length measurements made to date and are susceptible to environmental and instrumental artefacts contaminating the data. The presence of non-Gaussian noise transients, otherwise known as glitches, inhibit the detectors ability to distinguish true gravitational waves from the background noise. Glitches are broken down into categories based on their time-frequency representation. While many glitch classes have well understood causes and can be mitigated, those with unknown causes cannot. This study seeks to represent the data that is intrinsic to glitches and create meaningful visual representations of trends within the categories. In doing so patterns could be seen to gain a deeper understanding of the glitch class as well as possible patterns that can lead to discerning its cause.

E-93: Comparative Studies of the Superparamagnetic Properties of Engineered H-rich and L-rich Human Ferritins Reconstituted with 500 57Fe-atoms / Protein
Author: Longo, Thomas; Hurley, Lauren; Ji, Kaixuan; Papaefthymiou, Georgia
Advisor: Dr. Georgia Papaefthymiou-Davis

Ferritin is the iron storage protein found in most living organisms from bacteria to humans. It consists of two distinct parts: an inorganic core of ferrihydrite surrounded by an organic protein shell. In humans, ferritin is found in various organs such as the liver, spleen, brain, and heart. The protein shell is spherical with an inner diameter of 7 nm and an outer diameter of 12 nm. It consists of 24 amino acid subunits of two types: a heavy chain (H) and a light chain (L) subunit. The structure of ferritin varies depending on location; for example, ferritins in the liver and spleen are L-rich, while ferritins in the brain and heart are H-rich. These different types of ferritins are associated with different functions. H-rich ferritins are responsible for frequent iron trafficking while L-rich are responsible for long-term iron storage. Since iron deposits in the brain have been linked to neurodegenerative diseases, such as Parkinson's and Alzheimer's, it is important to study structure/function relations in these types of ferritin. Therefore, we investigated the iron biomineral cores reconstituted within engineered L-rich and an H-rich human ferritins. We used Mössbauer Spectroscopy (MS) to analyze the physical properties of the cores. MS is a nuclear Physics technique that allows us to "see" the electronic, magnetic and superparamagnetic properties of the core from the perspective of the iron nuclei. The MS signatures obtained in the temperature range of $4.2 < T < 300$ K for both proteins pass from six-line, magnetically split spectra at low temperatures to two-line, quadrupolar spectra at higher temperatures; a signature of superparamagnetism. The magnetic spitting of the L-rich core collapses to a quadrupole doublet at a higher temperature ($T_B = 21$ K) compared to the H-rich core ($T_B = 11$ K). We used the characteristic measuring time of MS of 10-8 s within the Néel uniaxial magnetic anisotropy model for spin-relaxation-time processes in magnetic nanoparticles in order to extract information on core size. Our analysis indicates that, under similar iron-core reconstitution conditions, H-rich proteins tend to form smaller cores with a larger surface-to-volume ratio, therefore favoring high iron trafficking; while L-rich proteins form larger cores with a smaller surface-to-volume

ratio, favoring long-term iron storage. These observations provide for a structure/function correlation in understanding the markedly different functions of the H-rich and L-rich proteins.

E-94: HAWC+/SOFIA Multiwavelength Observations of OMC-1
Author: Michail, Joseph; Thapa, Rahul; Chuss, David; Guerra, Jordan (HAWC+ Science Team); Siah, Javad (HAWC+ Science Team)
Advisor: Dr. David Chuss

The Orion Molecular Cloud-1 (OMC-1), located at a distance of about 380 pc, is the closest and most well-studied massive star-forming region in our galaxy. We present new far-infrared results from the High-resolution Airborne Wideband Camera+ (HAWC+) instrument that flies on the NASA/DLR SOFIA telescope. HAWC+ is a photometer and polarimeter capable of observing dust at four different far-infrared wavelengths. Using complementary datasets from the Herschel Space Observatory and the SCUBA-2 instrument, we fit new modified spectral energy distributions for this region to extract information about the temperature and density distributions in this cloud complex. In addition, we use the HAWC+ polarimetry in all four bands to determine the geometry and strength of the magnetic field and gain new insight as to the role of the magnetic field in the cloud dynamics.

E-95: Development of a Prototype Cosmic Microwave Background Calibration Target
Author: Stilwell, David; Greene, David
Advisor: Dr. David Chuss

The capability to construct devices that have low reflectance (and high absorptivity) of electromagnetic radiation at long wavelengths has many potential applications ranging from radar evasion to EMI control to calibration of sensitive detectors for cosmology. In cosmology, characterization of the spectrum and polarization of the cosmic microwave background, the afterglow of the Big Bang, requires measurements that are accurate to one part in 10^9. We describe the fabrication of a prototype cosmic microwave background calibration target that consists of an array of 169 cones each constructed of loaded epoxy that is molded around an aluminum core for mechanical attachment and thermal stability. These processes were developed as a key technology to support a future NASA space mission to measure the spectrum and polarization of the cosmic microwave background to probe the physics of the early universe.

E-96: Early Solar System Irradiation Effects on Short-Lived Radioisotope Production
Author: Williams, Connor; Collon, Philippe; Anderson, Tyler
Advisor: Dr. Philippe Collon (University of Notre Dame)

Short-lived radioisotopes (SLRs) with half-lives < 100 Ma are known to have existed during the formation of the solar system around 4.5 billion years ago through the detection of their decay products in meteorites. The origin of SLRs in the solar system is understood through two main production hypotheses. It is believed that a nearby supernova, Wolf-Rayet star, or thermally pulsating Asymptotic Giant Branch (AGB) star, injected newly synthesized SLRs into the Giant Molecular Cloud (GMC) from which the sun was formed, possibly contributing enough mass to engender the collapse of the cloud itself. However, the concentration of the decay products of 36Cl, 26Al, and 60Fe, exceed their expected galactic steady-state enrichment levels, suggesting that a secondary production source may be responsible for the excess. In the sun's infancy, solar energetic particles (SEP) may

have irradiated gas and dust present in the solar accretion disk, aiding the accumulation of SLRs in chondrules and Ca-Al rich inclusions (CAIs). Determining the origination of SLRs may lead to a heightened understanding of the manner in which the solar system was formed. Experimental data is needed in order to validate the solar irradiation model, and therefore, the cross sections of the nuclear reactions in question must be measured. The cross section of the 35Cl(3He,2p)36Cl reaction was estimated in order to evaluate the feasibility of creating the reaction in a laboratory setting. Based off of cross section predictions, seven activation energies within the range of 1.44 MeV/A to 2.51 MeV/A are proposed for future measurement.

E-97: Application of a Retired Burst Gravitational Wave Data Analysis Method to Investigate the Origin of Blip Glitches
Author: Choate, Sarah; Stuver, Amber
Advisor: Dr. Amber Stuver

The Laser Interferometer Gravitational-Wave Observatory (LIGO) is a collaboration with the goal to observe and study events that create gravitational waves detectable on Earth, such as the coalescence of black holes or neutron stars. During the process of data acquisition, glitches in the data can occur as a result of the observation of transient noise. One class of these glitches that occurs in burst data analysis is the blip glitch, which results in an almost identical signal to that of a gravitational wave detection. The origin of this glitch is unknown and previous analyses have failed to locate a source. SLOPE is a data analysis method originally used for gravitational wave detection. This research has redeveloped SLOPE for the purpose of investigating glitches, like the blip glitch. Results presented include detection efficiency of simulated glitches.

Psychological & Brain Sciences

E-98: Effects of hearing difficulty on intensity discrimination: a psychophysical test for auditory neuropathy
Author: Saccocia, Gwen; Toscano, Joseph C.
Advisor: Dr. Joseph C. Toscano

This study investigates why some human listeners report having difficulty understanding speech, despite displaying normal audiograms that do not suggest a hearing loss. The experiment is designed around a proposed model of the degeneration of the auditory nerve (a condition known as auditory neuropathy) that predicts deficits in hearing at the level of conversational speech but not at the listeners' hearing threshold. In particular, this study aims to detect this type of hearing loss by measuring sound level discrimination thresholds at different frequencies and intensities. In the experiment, listeners hear pairs of tones, and their task is to select whether the first or second tone is louder. The tones vary in frequency, intensity, and the difference in sound level between the two tones (from 1 to 4 decibels). This provides a measure of the smallest sound level difference that the ear can detect, referred to as the discrimination threshold. The subjects also complete an audiogram and self-report hearing questionnaire. To examine the results, the subjects were divided into groups based on their self-reported hearing difficulty. Significant differences in task performance as measured by point of subjective equivalence (PSE, 50% responses of tone 2 louder) are found at higher intensities and frequencies, where speech sounds are found. There were no significant differences in PSEs at lower sounds irrelevant to speech. The results show that listeners with reported hearing difficulty do not

have significant differences in just noticeable differences (JNDs), the threshold at which they can detect a difference in intensity. Instead, they have their PSE shifted left and are more likely to respond that the second tone was louder, even when it was not. The results support the proposed model because significant differences are seen only at relevant speech frequency and intensity combinations. An intensity discrimination task may be a reasonable clinical test for auditory neuropathy.

E-99: Influence of Dialect Region on Vowel Perception and Vowel Production
Author: Feeley, Nicole; Toscano, Joseph C.
Advisor: Dr. Joseph C. Toscano

Previous research on speech processing has yet to fully explore how vowel sounds are produced and perceived by talkers and listeners of different dialect regions. The present study investigated this across two tasks that aimed to establish whether there is an effect of dialect region on perception or production. Subjects participated in a vowel identification task in which they heard synthesized vowel sounds varying along F1 and F2 continua in nine steps each and identified the vowel as /u/ ("boot"), /V/ ("but"), /o/ ("boat"), or /a/ ("bot"). Participants also completed a production task in which they read the same words to allow for the measurement of the acoustic characteristics of their vowels. Lastly, participants completed a residency questionnaire to determine which of the six regional dialects of American English (based on those identified in the Telsur Project; Labov, 1997) they had lived in for the longest period of time. For the production data, we found a main effect of vowel category and gender for both F1 and F2. In addition, there were differences based on dialect, such that talkers from the Midland region produced significantly higher F2 values and marginally higher F1 values for /o/. For the perception data, there was a main effect of F1 and F2 and an interaction between F1 and F2 on listeners' categorization of the vowels, but no effects of dialect. Similarly, an analysis of participant's category boundaries suggested differences in production based on dialect (higher F1xF2 category boundaries for Midland speakers), but no differences in perceptual boundaries. Thus, while dialect affects F1 and F2 values for vowel production, listeners' vowel perception does not appear to be influenced by their dialect. This suggests that listeners may not rely on their own prior experience of dialect when encountering an unknown talker, but instead may assume the dialect of the talker (i.e., that they were a Midland talker). The results help us better understand how speech sounds vary across different dialects and help clarify what information listeners use to make inferences about a novel talker.

E-100: Stressful Life Experiences and Maternal Distress in Families Experiencing Homelessness
Author: Keane, Joanna; Cutuli, J. J.; Herbers, Janette
Advisor: Dr. Janette E. Herbers

Parents undergoing episodes of homelessness experience a multitude of stressors beyond those of typical parenting (Cutuli & Herbers, 2014, Perlman et al., 2012). Risk and resilience literature has utilized cumulative risk models to predict outcomes and demonstrate that the buildup of multiple risks and stressors is more predictive than models using single risk factors. However, a general count of stressors or risks is too simplistic, failing to consider the differential effect of specific stressors on unique individuals (Evans, Li, & Whipple, 2013). We sought to demonstrate that categorization of maternal risks and stressors is more predictive of parenting distress than a simple count. In order to focus solely on the effects of the adversity, we controlled for social support, as it can alleviate feelings of psychological distress (Belsky, 1984). Participants included 75 mothers with children under age

three, recruited from 6 different family shelters in Philadelphia. Mothers responded to questions in a structured interview including demographics and items about their homeless episodes as well as the Life Time Events Questionnaire (Masten et al., 1999), which contains 23 possible adverse events in the mother's life. The outcome of current distress was assessed by the Symptom Checklist, a brief measure of internalizing symptoms in the past two weeks (Derogatis et al., 1974). Social support was measured by the number of people the mother endorsed in an interview question regarding potential providers of emotional, psychological, or financial support. We assessed three different categories of adversity: interpersonal violence, intrapersonal problems, and resource-related risks. Interpersonal violence refers to physical contact between the parent and another person resulting in harm, intrapersonal problems refer to internal or external issues causing significant distress and impairment, and resource-related risk refers to diminished resources, such as having less than a high school education or previous homelessness. Variables represented sums of the items from each category. We created a cumulative risk variable as the sum of the three individual categories. Controlling for social support, we utilized a linear regression model with the outcome of parental distress predicted by the three separate types of adversity ($R2 = .280$, $p = .007$). Interpersonal violence ($\beta = .257$; $p = .018$) and intrapersonal problems ($\beta = .270$; $p = .015$) were significant predictors. We then compared this to a model in which parental distress was predicted by cumulative risk ($R2 = .170$; $p = .139$). The cumulative risk model did not explain as much of the variance and was not statistically significant. These results indicate that a categorization of maternal stressors better predicts differences in current distress than a simple count of all stressors. This implies that different stressors and risks have different impacts on parents in emergency housing. Our results suggest that supports be put in place in the shelter environment to address these specific risks and stressors, rather than having a one-size-fits-all approach to support. These findings have implications for approaches to future analysis in risk and resilience literature. Potential future directions could include investigating the recency of the stressors and risks.

F-101: New "You" in a New Land

Author: LaPorte, Emily; Ranganathan, Eishna; Giffels, Keegan; Orvell, Ariana
Advisor: Dr. Ariana Orvell (University of Michigan)

Norms are an important part of our social world, guiding expectations for behavior among groups. Children are sensitive to norms, which apply to groups of people, starting early in development. Prior research shows that children are sensitive to "generic-you," which refers to people in general, and use it to respond to questions about norms. Here, we examine whether such subtle shifts in language may shape how children learn about norms in a novel context. The current study tests whether children (N=58, ages 6-12 years) rate norms in a made-up planet, "Cortania," where people do things differently than they do on Earth, as more favorable when they contain "generic-you" as opposed to "I." These findings may have implications for how parents and educators communicate norms. Further work may also examine the presentation of "generic-you" by an authority figure vs. a peer.

F-102: Temporal Anticipation of Contrasting Reward

Author: Matell, Matthew; Patel, Ankita
Advisor: Dr. Matthew Matell

There is a evolutionary motivation to seek maximal payoff in exchange for performed work. This natural tendency can be used to investigate temporal perception in rats. When presented with two rewards that have varying levels of value, rats will inevitably have a preference for the reward with higher value. Therefore, rats with acute temporal perception show diminished efforts to work,

preserving their energy for the time at which they expect the reward with higher value. In this experiment, subjects were given an opportunity to work for a minimal-value reward for an interval of time, followed by a maximal-value reward for an interval of time. Subjects showed a diminished effort to work prior to the onset of the maximal-value interval, indicating an accurate temporal perception, and controlled temporal anticipation of reward.

F-103: Investigating the Contributions of Visual Similarity and Sleep to Statistical Learning

Author: Perez, Gianna M.; McDevitt, Elizabeth A.; Wammes, Jeffrey D.; Norman, Kenneth A.; Turk-Browne, Nicholas B.
Advisor: Dr. Kenneth A. Norman (Princeton University & Princeton Neuroscience Institute)

Statistical learning (SL) of regularities in the environment shapes how information is represented in the brain and influences behavior. For example, if one image reliably follows another within a stream of images, the neural representations of these images become more similar; this effect is modulated by visual similarity (VS) between the images, such that low VS items become more similar and high VS items become less similar (Schapiro et al., 2012). Behaviorally, these effects are expressed as decreased or increased discriminability between the images, respectively. Here, we aim to test if consolidation processes during sleep facilitate these representational changes, as measured behaviorally. We will test 40 participants in a between-subject design; each participant will be tested with either a 90-minute nap or wake between SL and a discrimination test. In the SL task, participants view a series of images. Unbeknownst to participants, the series is generated from image pairs, which vary in VS, with pairmate images always appearing successively. To behaviorally measure SL, participants perform a discrimination test where both items from an SL pair are repeatedly presented in a rapid serial visual presentation stream, mixed in with control items; participants have to judge how often individual items are presented (Schapiro et al., 2012). We predict that low VS pairs will be more confusable after SL, leading to frequency overestimation; members of high VS pairs should show the opposite effect. We hypothesize these effects will be significantly greater in the sleep, compared to wake, condition.

Special appreciation to the following sponsors:

Office of the Provost

Center for Research and Fellowships

College of Liberal Arts and Sciences

College of Engineering

M. Louise Fitzpatrick College of Nursing

Villanova School of Business