

Using Shared Frailty Modeling to Study Alternative Cell Fates

Rachel Leander, Faculty, Mathematics; Yeqian Liu, Faculty, Mathematics

Variability in cellular decisions, *e.g.* the decision to die or divide, has the potential to yield new insights into the principles of cellular decision-making. At the same time, variability can have important implications for population level behaviors and the response to therapy. As a result, variability in cellular decisions has been a topic of intense biological research for decades. Previously, we proposed a model that describes the decision to divide as a sequence of drift-diffusion processes, coupled to thresholds. This model has been shown to possess both descriptive and predictive power. In this work, we extend the current model to account for alternative cell fates; *i.e.* both death and division, by employing a shared frailty modeling approach. In addition to providing estimates of the parameters controlling each individual decision, this approach enables us to infer dependencies between decision processes. At the same time, we further develop a custom numerical method for maximum likelihood parameter estimation, which involves an implicit characterization of the maximum likelihood parameter estimates.

Graham and Zeke: A Short Documentary Film

Allie Sultan, Faculty, Media Arts; Cheryl Newsome, Undergraduate student, Media Arts

TRT: 8 minutes

LOGLINE

A transgender couple from Tennessee share their insights surrounding love, gender, and pet snakes.

SYNOPSIS

Graham and Zeke is a short documentary film about a transgender couple from Smyrna, Tennessee. It seeks to broaden the general public's understanding of the transgender experience at a time when the general public perception of their identity is dominated by negative stereotypes and fear. Through the film, the viewer comes to understand the struggles that transgender people face in order to live their lives authentically.

Graham Bell and Zeke Miller met online – a shared love of snakes and video games brought them together. Both were born biologically female, and are in various stages of transitioning to the gender they identify with. As a couple, they have been there for each other throughout their transition, giving each other strength and humanity where the society at large is not. It hasn't been easy, but together they are working to make their world a kinder and more tolerant place.

CATALYST, AUDIENCE, AND PROGRESS

We made this film to educate people who have never met a transgender person before – whose attitudes and opinions about the transgender community have been formed by misinformation. The consequences are real for transgender people, who deserve to be understood and respected as individuals and not as false stereotypes.

This film is an important catalyst for dialogue in academic and cultural spheres, as it examines ideas of gender from a first-person perspective. What does it mean to be a man? Is gender a fixed human property, or is it constructed by societal expectations and norms? Can love heal the wounds that an unforgiving society inflicts?

This short film is fully complete and has been entered into film festivals across the United States.

PROJECT LINK:

http://www.greenscootfilms.com/films/GRAHAM_AND_ZEKE_CC_FF.mp4

Trends in Agricultural Production Efficiency and Their Implications for Food Security in Sub-Saharan African Countries.

Bichaka Fayissa, Faculty, Economics and Finance; Christian Nsiah, Faculty, Economics & Finance, Baldwin Wallace University

The main objective of this paper is to estimate trends in the agricultural sector production efficiency of a cross-section of African countries over time using panel data and data envelopment (DEA) type analysis in order to assess the state of food security, or insecurity in the African continent. In particular, the study employs data for 49 African countries from 1995 to 2012 to estimate the year to year agricultural efficiency for cereal, crop, food, and non-food sectors against natural inputs for the agricultural sector. We analyze the determinants of annual efficiency scores and their growth rate, and subsequently investigate the impact of agriculture efficiency on food security. We find that the agriculture aid, capital infrastructure for the agriculture industry, sanitation, and good governance are the main drivers of agriculture efficiency and its growth. We find that a large portion Africa's agriculture sector growth for the period under consideration can be attributed to technical progress as opposed to efficiency changes. Substantively, we find that agricultural efficiency has a positive and significant impact on food security in Africa.

Genome-wide Identification and Characterization of Long Non-Coding RNAs in Tilapia (*Oreochromis niloticus*)

Walaa Shaalan, Visiting scholar, Biology; Ali Ali, Graduate student, Biology; Nassr Allah Abd El-Hameid, Non-MTSU university faculty collaborator, Biology; Sabry El-Serafy, Non-MTSU university faculty collaborator, Biology; Mohamed Salem, Staff, Biology

Long non-coding RNAs regulate various biological processes including fish growth and disease resistance. In this study, RNA sequencing reads from 12 tissues of tilapia were mapped to a genome reference and assembled into 42,200 transcripts using HISAT2/StringTie suite. In total, 14,186 long non-coding RNAs were identified after the filtration of transcripts with protein-coding potential. Of them, 6,118 transcripts were categorized as antisense (AS-lncRNAs), transcribed from the opposite strand of protein-coding loci. 14.4% and 69.5% of long intergenic non-coding RNA (lincRNA) and AS-lncRNAs were multi exonic, respectively. Investigation of long non-coding RNA tissue specificity revealed 1,056 and 1,010 tissue-specific lincRNA and AS-lncRNA transcripts, respectively. Remarkably, ovary and testis showed the largest number of tissue specific lincRNA and AS-lncRNA transcripts; 678 and 837, respectively. This study represents a comprehensive genome-wide analysis of tilapia lincRNAs/AS-lncRNAs and provides invaluable genomic resources for future functional genomics studies in tilapia.

The Falling Wooden Idols

Marie Elliott, Faculty, Media Arts; Frank Barnas, Faculty, Broadcast Journalism and Documentary Production, Valdosta State University

The Falling Wooden Idols is a documentary that investigates the preservation efforts of a wooden sculpture garden in Scotland. Using video ethnographic research, we examine the artistic choices made as the wooden carvings face eventual environmental decay. The ongoing efforts to preserve the Frank Bruce Sculpture Trail in Scotland was documented by myself and my co-investigator and husband Frank Barnas. The now-deceased sculptor urged that his wooden sculptures be allowed to naturally decay back into the soil. The finished documentary visually examines both the purpose of the sculptures and how the artists' choices affected the local community.

The use of digital video as a tool to collect artifactual data about people, places, events, and social problems allows me to translate traditional written observations into audio visual data therefore giving me an alternative approach to academic research in my field. Using ethnovideography as a research methodology provides me with an alternative to conventional social analysis and allows me to act as both an independent investigator and creative artist. With my background in filmmaking and my knowledge of documentary production, I have been able to establish myself as a visual anthropologist and be set apart from other artists in my field thus increasing my chances for scholarly publication and adjudicated creative awards.

The importance of this activity is threefold. First, it will document one of the few wooden sculpture gardens left on the planet. Not only is the Frank Bruce Sculpture Trail a rarity of its artistic medium, its geographic location in Scotland subjects the external works to constant climatic changes and variances. Second, the iconography of the sculptures encompasses the paganism, religion, history, and culture of a largely forgotten land, The Scottish highlands. Finally, this documentary provides epistemological evidence to validate ethnovideography as a research method.

Inferred Reactivation of Basement Structures within the Nashville Dome, Central Tennessee

Mark Abolins, Faculty, Geosciences

The Nashville dome, central Tennessee, is an approx. 12,000 sq. km north-northeast-trending, elliptical cratonic uplift. A published crustal density model shows that a previously-undescribed Precambrian or Cambrian rift, the Nashville rift, probably runs north-northeast from northwestern Alabama through the Nashville dome to southern Kentucky. Within the Nashville dome, macroscale folds and mesoscale structures of the Stones River and Harpeth River fault zones have been interpreted previously as the surface manifestation of sub-surface normal faults. New research reveals two previously-undescribed inferred sub-surface fault zones: the Marshall Knobs fault zone (MKFZ) and the Northern Highland Rim fault zone (NHRFZ). The MKFZ is inferred to lie in the sub-surface beneath the southern edge of the Marshall Knobs syncline (MKS). The MKS is near the center of the Nashville dome, is ~16.3 km long, is associated with ~35 m of structural relief, and trends east-southeast. The inferred fault zone is down on the north side. The NHRFZ is on the northern periphery of the dome and consists of east-northeast-striking minor normal and reverse faults and a minor strike-slip fault. The authors hypothesize that the NHRFZ may be related to the sub-surface continuation of a macroscale fault previously-mapped at the surface 25 km to the southwest. All of the inferred faults fit into a tectonic model in which they originally formed within a rift and later reactivated, accommodating extension of the uppermost crust during uplift of the Nashville dome.

Milly and Roots - Animated Series

Rodrigo Gomez, Faculty, Media Arts

The world is facing today historical numbers of migrant communities due to the economy and socio-political challenges. It is always hard to change the mind of adults in settled cultures to receive foreigners, but there is hope if the target audience are the children who are more receptive to messages that appeal to their true human spirit. The final goal of this creative project is the production of a preschool animated series that will introduce in a friendly and humorous format, concepts of tolerance and understanding towards those people who may be foreign to children.

Audience: 3 to 5 years old.

Episode length: 5.5 minutes.

Number of episodes: 52.

Story: Milly is a shy but very curious girl, she lives with mom and grandma in a tiny city apartment, she just started kindergarten and she hates it, too many new and strange people. Milly's view of people is about to change when she discovers a world through grandma's garden. A potato with incredible powers introduces Milly to other vegetable root friends around the world, and through them to all sorts of new people, cultures, places and flavors that she never expected. The new experiences help Milly grow and understand the world around her.

Status: A pitch bible was created, containing the story principles and art style of the property. This document was presented to professionals of the entertainment industry at the Kidscreen Summit in February 2018. The document received praise and valuable comments from peers and a number of broadcast networks. The next stage of the project will generate the writing of a children's book to test the origin story. The book will be the base for a pilot episode that will be produced and presented to broadcasters worldwide, with a goal to find funding to produce the series.

Classifying Magnetic Resonance Image Modalities with Convolutional Neural Networks

Samuel Remedios, Undergraduate student, Computer Science; Dzung Pham, Industry collaborator; John Butman, Industry collaborator; Snehashis Roy, Industry collaborator; Joshua Phillips (Faculty sponsor) Computer Science

Magnetic Resonance (MR) imaging allows the acquisition of images with different contrast properties depending on the acquisition protocol and the magnetic properties of tissues. Many MR brain image processing techniques, such as tissue segmentation, require multiple MR contrasts as inputs, and each contrast is treated differently. Thus it is advantageous to automate the identification of image contrasts for various purposes, such as facilitating image processing pipelines, and managing and maintaining large databases via content-based image retrieval (CBIR). Most automated CBIR techniques focus on a two-step process: first extracting features from the data and then classifying the image based on these features. We present a novel 3D deep convolutional neural network (CNN)-based method for MR image contrast classification. The proposed CNN automatically identifies the MR contrast of an input brain image volume. Specifically, we explored three classification problems: (1) identify T1-weighted (T1-w), T2-weighted (T2-w), and fluid-attenuated inversion recovery (FLAIR) contrasts, (2) identify pre vs post-contrast T1, (3) identify pre vs post-contrast FLAIR. A total of 3418 image volumes acquired from multiple sites and multiple scanners were used. To evaluate each task, the proposed model was trained on 2137 images and tested on remaining 1281 images. Results showed that image volumes were correctly classified with 97.57% accuracy.

Nutrition in the Media

Aubree Davis, Undergraduate student, Interior Design; Dasia Ballard, Undergraduate student, Social Work; Sandra Cavender (Faculty sponsor) English

With the rise of preventable health issues, it's important that citizens are receiving accurate information on how to properly care for their bodies as best they can. However, the widespread use of social media platforms have only increased the misinformation about health and nutrition. Though quick access to work out plans and detailed diets can be beneficial for some, most posts and topics presented on these sites are pushed onto consumers by paid celebrities or consultants. These products do not have scientific testing to prove that they work as intended and when misused can cause more harm than good.

This presentation showcases a few of the major products and misconceptions that consumers are led to believe will better their health on a few of the most common media platforms. It also includes the daily recommendations for exercise and nutrition needs for adults put forth by reputable associations and government agencies that have undergone multiple studies proving their validity.

Potential Health Risks of Dyes Used in Color Run Powders

Teresa Tran, Undergraduate student, Chemistry; Beng Ooi, Faculty, Chemistry; Beng Ooi (Faculty sponsor) Chemistry

Organizers of color run events always recommend that participants wear goggles and dust masks for protection during the run. This is because the color powder may have potential health risks such as eye and skin irritation as well as airway inflammation, which can lead to tissue damage. The purpose of this research is to identify the color dyes present in the color-run powder using the nuclear magnetic resonance (NMR) spectroscopy. The NMR spectra of colored dyes extracted from the powder are compared with the reference spectra of color dye standards. Identification of the dyes is also confirmed by previous analyses based on gas chromatography-mass spectrometry (GC-MS) and quadrupole-time-of-flight mass spectrometry (qTOF-MS). Literature search of the toxicological profiles of the identified dyes will be presented.

Does the use of a 'Sonic Net' Disturb the European Starling (*Sturnus vulgaris*) and Deter them from the Murfreesboro Airport?

Ifeanyi Onuh, Undergraduate student, Biology; Sarah Mikhail, Undergraduate student, Biology; Jarred Millard, Undergraduate student, Biology; Marisa Rust, Undergraduate student, Biology; Danielle Brown, Faculty, Biology; Danielle Brown (Faculty sponsor) Biology

Avian wildlife is considered a nuisance problem at airfields. Noise cannons and similar temporary deterrents used with large flocks of European starlings (*Sturnus vulgaris*) have generally been unsuccessful because the birds simply return once the cannon is done firing. Detering starlings from airfield runways has been achieved by playing a 'sonic net' continuously and at high volume. The 'net' is a wide band of frequencies that overlaps with the frequencies the birds use for communication.

In this study we focused on interrupting the nesting and roosting behavior of starlings in a 727 aircraft used for maintenance training at the Murfreesboro, TN airfield. The goal of our project was to displace starlings from the parked plane. We predicted that, following the introduction of a noise stimulus similar to the sonic net, there would be fewer birds roosting on the plane and nests would be abandoned. We observed birds 2-4 times each week from March-July 2017 at the airplane (experimental site) and May-July 2017 at a control site 300 m away on the airfield. Observations began at 0730 (+/- 10 minutes) and counts were performed every 5 minutes for thirty minutes. We did not observe birds when it was raining. In June at the experimental site, we placed a speaker on a pole behind the 727. It played, continuously, 15-30 seconds of 8 different clips of 'white noise' with frequencies between 2-10 kHz. After the final observation period and before removing the speaker, we measured the stimulus volume around the airplane at 5 meters intervals and at 3 heights (below, above and at speaker level) with a manual sound pressure level meter.

We are currently analyzing the results to determine if bird activity at the plane declined with the introduction of the noise stimulus, when compared with the control site.

Investigating the Immune Response to *Cryptococcus neoformans*

Muhammad Fariz Ali, Undergraduate student, Biology; Rebecca Seipelt (Faculty sponsor)
Biology

Background: *Cryptococcus neoformans* (Cn) is a fungal pathogen that kills more than 181,000 people each year. Several organisms are used as *Cryptococcus* pathogenesis models, including mice, mammalian cells, and wax moth larvae, *Galleria mellonella*. The wax moth larvae are used as a model of mammalian pathogenesis for a range of bacterial organisms, such as *Klebsiella pneumoniae*. They have phagocytic hemocytes which engulf and kill microbes similarly to neutrophils. Neutrophils kill microbes using reactive oxygen species (ROS), which are damage-inducing including peroxides and superoxides. Methods: To investigate pathogenesis, a strain of *C. neoformans* (H99W) was serially passaged in *Galleria* larvae 15 times which equates to 100 generations (P15). Phenotypic characterization showed P15 has more capsule and sheds more capsule than H99W. Growth, infection, and histology studies were conducted to examine the difference in pathogenesis of P15 compared to H99W. Growth studies were conducted by measuring growth of each strain in hemolymph-containing medium. Infection studies were conducted by infecting *Galleria* and measuring both fungal burden and the ability of isolated hemocytes to produce hydrogen peroxide. Lastly, histology studies were conducted by infecting *Galleria* and examining stained larvae sections for immune nodules. Results: Compared to H99W, P15 grew quicker in medium containing hemolymph, had a greater fungal burden at day 3 post-infection, induced less hydrogen peroxide from hemocytes, and infected larvae showed more abundant immune nodules, which are similar to granulomas. Conclusions: These results indicate that P15 modulates the *Galleria* immune response, grows quicker in the hemolymph environment, and is more virulent in *Galleria*. Currently, an infection study is underway to determine the role of capsule production and shedding on hemocyte hydrogen peroxide production as a possible mechanism to explain P15's ability to modulate the *Galleria* immune system and its virulence in *Galleria*.

Media Influences on Public Opinion of the Police

Madeline Peters, Undergraduate student, Criminal Justice Administration; Jade Johnson, Undergraduate student, Speech Pathology and Audiology; Sandra Cavender (Faculty sponsor) English

This project analyzed the effects that the media has on police departments and on public perception of the police. There has been a lot of scrutiny concerning the police due to constant media coverage on police brutality and excessive force. This coverage has created a stigma around the police, when in the past the police has been considered a praiseworthy profession. The project describes the positive outcomes of the media attention and the negative effects that media coverage has had on the police. The positive outcomes have been departments being forced to deal with their shortcomings and update their use of force training. Departments have also been engaging in more community-outreach programs to reinforce community trust. On the other side, police officers have been losing motivation and morale due to the harsh media coverage. Our project even describes a situation where an officer did not use lethal force on an aggressor due to fear that passersby would misunderstand and record the incident, which resulted in the officer have their head banged into the pavement multiple times. The project also describes the how the “YouTube Effect” and “Media Framing” has played a part in the way police have been projected in the media today.

Searching for Macroscale Folds in the Nashville Dome, Central Tennessee

Christiana Rosenberg, Undergraduate student, Geosciences; Mark Abolins (Faculty sponsor)
Geosciences

In some parts of the Nashville dome, central Tennessee, gentle folds probably formed long ago through the movement of sub-surface faults. Searching for faults, the author examined folds in the Gallatin and Bethpage 7.5' quadrangles on the northern flank of the Nashville dome. Using the software program ArcGIS, a digital geologic map, and the National Elevation Dataset (NED), the author extracted elevations to points on the contact between the upper Ordovician Sequatchie formation and the underlying Ordovician Leipers and Catheys formations. These points were then used to create a structure surface and structure contours showing the elevation of the geologic contact. Contours which are relatively closely-spaced and linear reveal relatively steep fold limbs, and these relatively steep limbs might reveal the locations of sub-surface dip-slip faults. This analysis led to the hypothesis that there might be a north-side-down sub-surface fault striking $\sim 290^\circ$ and having an associated structural relief of ~ 15 m. The hypothetical fault is ~ 3.2 km in length, and it is located in the vicinity of Dry Fork Creek ~ 11 km NE of Gallatin, TN.

Effects of Predation Risk on Habitat Selection by Two Cryptobenthic Blennies (*Helcogrammoides spp.*) in a Central Chilean Coastal Ecosystem

Brooke Fitzwater, Undergraduate student, Biology; Dennis Mullen (Faculty sponsor) Biology

Prey fish species have been shown to alter their behavior in the presence of predators, and predation has been shown to alter habitat selection in fish as well. Two species of cryptobenthic marine blennies, *Helcogrammoides chilensis* and *Helcogrammoides cunninghami* (Family Tripterygiidae), are found on the productive shallow coasts of Chile which are dominated by heterogeneous habitats containing *L. trabeculata* and rocky reef beds. The objectives of this research were to 1.) determine if the presence of a predatory fish (*Sebastes oculatus*) affected habitat selection by the two triplefin blennies, and 2.) explore the relationship between all three fish species and the kelp habitat. *Helcogrammoides spp.* specimens were placed individually in a large circular pool and were allowed to select between three habitats ("*L. trabeculata*," "rocks," or "sand") for a duration of ten minutes. Two adjacent, translucent compartments were on either side of the habitat choices, and a singular *S. oculatus* specimen was either present or absent from one of these compartments during the trial. Trials were filmed on a GoPro camera and the footage was later analyzed to determine *Helcogrammoides* habitat choices. Preliminary results showed that predator influence on habitat selection by *Helcogrammoides spp.* is possible, and this relationship may therefore be important to understanding the role of kelp in the ecosystem, especially since kelp is in decline. Research is ongoing and will be continued in the near future.

Visual Catalog of the Fishes of the Stones River in Middle Tennessee

Brooke Fitzwater, Undergraduate student, Biology; Dennis Mullen (Faculty sponsor) Biology

Natural history art has long been used as a scientific tool to describe various species and their respective life cycles. These are valuable to both scientists and the general public as they can be used as references to allow individuals to identify an organism to species and also serve to compile all aspects of a species' life history in one place. There is a relative lack of natural history art that details species in Tennessee, and there is especially a lack of natural history art describing fishes. This project explores the fishes of the Stones River water system, which runs through Murfreesboro, Tennessee, through a series of watercolor paintings that include art pieces focused on illustrating the general appearance of the species for identification purposes and, for some of the most common species, life history aspects such as nesting sites and coloration of the males during breeding season. This project seeks to visually catalogue the fishes of the Stones River to create a key that represents a sample of the more common fishes in this water system. The Stones River is facing pressure from human activities that affect these fishes, and this project will help to raise awareness about the diversity of fishes present in this water system and hopefully inspire conservation efforts to protect them.

The True Costs of Private Security Officers

Matthew Moore, Undergraduate student, Criminal Justice Administration; Ben Stickle, Faculty, Criminal Justice Administration; Ben Stickle (Faculty sponsor) Criminal Justice Administration

The objectives of this research are to (1) identify and compare the number of private security officers killed in the line of duty, (2) examine what caused their deaths, (3) identify the circumstances surrounding the death (i.e., types of locations, weapons), (4) provide details on the demographics on security officers killed, (5) enhance the discussion of this often neglected topic in criminal justice, and (6) disseminate this knowledge, in the form of a poster, at MTSU Scholars Week.

Infectivity of Novel Intracellular Bacteria for Eukaryotic Cells

Andrew Swehla, Undergraduate student, Biology; Mary Farone (Faculty sponsor) Biology

Three different cell lines, *Dictyostelium discoideum*, *Acanthamoeba polyphaga*, and U937 cells, were infected with a novel bacterium, *Candidatus Berkiella cookevillensis* (CC99). The level of infectivity within the cells was observed using Giemsa staining combined with microscopic observation. The first goal of the study was to determine if the bacteria would infect the cells of the model organism *D. discoideum*, so that future studies could be done on pathways of infection. The second goal of the study was to determine the ability of the bacteria to pass between different cell types or hosts. CC99 was passed between *A. polyphaga* cells, from *A. polyphaga* cells to U937 cells, and between U937 cells. The bacteria were observed in the nucleus of *D. discoideum* cells by 24 hours post-infection, and after 48 hours 100% of the nuclei were infected. The CC99 bacterium was shown to be capable of passing between *A. polyphaga* cells, from *A. polyphaga* cells to U937 cells, and between U937 cells. The nuclei of *A. polyphaga* cells reached 100% infection by 48 hours post-infection, while the nuclei of the U937 cells did not show significant levels of infection until 72 hours post-infection, with up to 70% infected. This information provides basic infectious behavior information about the CC99 bacteria and will allow for future studies to be performed on the mechanisms of infection of the bacteria.

Orchestrating O'Carolan: Initiating a Folk Composer into a Baroque World

Sarah Wilfong Joblin, Undergraduate student, Music; Carol Nies (Faculty sponsor) Music

This project will focus on a melody by the Irish folk composer Turlough O'Carolan (1670-1738), called James Betagh. O'Carolan was a folk musician who deeply admired classical composers of the Baroque era, and strove to imitate them in his melody writing. Though he had no formal theoretical or compositional training, O'Carolan's melodies are beautiful and enduring. I am developing a set of criteria based on studying the orchestral works of Baroque composers Arcangelo Corelli and Antonio Vivaldi, and will apply them to O'Carolan's piece. The result will be a version of James Betagh orchestrated in a Baroque format, for chamber orchestra and a small group of soloists. Scholars of traditional Irish music in general and O'Carolan scholars in particular agree that O'Carolan's lack of formal training precludes him from being categorized as a Baroque era composer. This project is meant to be a natural evolution of O'Carolan's work, and to explore what O'Carolan's music might have become had the societal unrest and economic hardships in Ireland during the seventeenth and eighteenth centuries not been a barrier to his education.

The Relationship of Intrinsic and Extrinsic Constraints to Undergraduate STEM Instructors' Use of Research-Based Instructional Strategies

Gina Bishara, Undergraduate student, Biology; Grant Gardner (Faculty sponsor) Biology

Recent reform documents in undergraduate STEM education have reinforced the need for enactment of research-based instructional strategies (RBIS) to promote student learning, positive attitudes, and career success. Despite evidence as to the effectiveness of these methods, few STEM instructors have changed to a more student-centered instructional approach. The question remains, why do scientists who demand proof for scientific assertions in their research continue to use teaching methods that are not the most effective? In order to promote instructional change, it is important to understand the personal, professional, and contextual barriers that instructors are faced with when modifying instruction. The study discussed here seeks to better understand undergraduate STEM instructors' barriers to instructional change by examining the relationships between extrinsic and intrinsic constraints to implementation of RBIS. This portion of the work was guided by the following research questions: What are the levels of awareness and use of RBIS for STEM faculty? And, what extrinsic and intrinsic constraints to broader adoption of RBISs do STEM faculty report? The cross-sectional survey research study was conducted at two large, non-research intensive southern Universities in two separate states. An online survey was constructed and distributed to all faculty and graduate students within the College of Arts and Sciences with $n = 104$ responses obtained. Hypothesized intrinsic constraints included instructor reform-oriented beliefs (measured by the Teacher Beliefs Interview) and motivations (measured by the Goal Orientations Towards Teaching protocol). Perceived extrinsic constraints included eight adoption barriers, such as time and professional identity. The data suggests that there is a diversity of awareness of specific RBIS and that awareness does not necessarily lead to implementation. It also suggests that perceived resources and preparation time are the most frequent self-reported barriers. Regression analysis indicate gender, teacher beliefs, and learning approach goal orientations predict use of RBIS.

A Kantian Perspective on Bin Skipping: Ethics and Trash

Madison Ellis, Undergraduate student, Philosophy and Religious Studies; Dr. Mary Magada-Ward (Faculty sponsor) Philosophy

By working to understand the ethical concerns regarding food and its production culture, Peter Singer illustrates in his work *The Ethics of What We Eat* that the standard American diet is riddled with unethical practices, regardless of the intentions of the consumer. No matter the source of the food, some crinkle in the production method leaves not only the environment but the communities that produced the food worse off. This leaves readers with a desire to know what is the most ethical application of personal consumer practices- what is the best, or the most ethically permissible, way to feed myself? Are there any to begin with? Working from Singer's ethical dilemmas, the categorical imperative of Immanuel Kant, and the scrappy, underground writings of John Hoffman, a conclusion may be able to be found in the rejection of the monetary system of food exchange entirely. Instead, it may be more ethically permissible (and much more fun) to sustain oneself off the waste found from this consumer culture, circumventing the entire system itself.

Assessing Type 2 Diabetes Risk Perception among College Students and Creating Health Education Tools using the Health Belief Model

Kyeesha Wilcox, Undergraduate student, Global Studies and Human Geography; Bethany Wrye (Faculty sponsor) Health and Human Performance, and Erin Anfinson (Faculty sponsor) Art

Background: Studies (Amuta *et al.*, 2016; Reyes-Velazquez *et al.*, 2011) have shown that college students engage in poor health behaviors and have relatively low perceptions of type 2 diabetes, although illness prevalence is rising within this age group (CDC 2017). Additionally, Amuta, *et al.* (2016) found that gender does play a role in health behavior among college students. **Purpose:** The overall purpose of this project was to understand how MTSU students view type 2 diabetes and what steps can be taken to provide relevant health education tools to this age group. **Research Questions:** Our research questions were: 'Is low health behavior associated with low risk perception of type 2 diabetes?' and 'Are college students responsive to gender-based health education tools?'. **Methodology:** This project involved illustrating eight gender-based health education tools and administering an electronic survey. We used Qualtrics.com to administer the survey. Using the Health Belief Model (HBM), we generated seven survey topics including demographics, health behavior, health material relevance and four HBM constructs: perceived (p.) susceptibility, p. severity, p. benefits and p. barriers. For each construct, we created a male and female poster design using Adobe Illustrator. **Preliminary Results:** Preliminary results (n=71) suggest that students generally had low health behavior while maintaining a low risk perception of type 2 diabetes. Moreover, the results also indicate MTSU college students are typically responsive to gender-based health education tools. **Significance:** By utilizing a multi-disciplinary approach to researching health, we hope to add to existing literature and find new ways to combat type 2 diabetes. As type 2 diabetes cases rise among this age group, a focus on college students' potential risk and perception of type 2 diabetes development is necessary for working towards offering a healthier environment for students.

Determinants of Life Expectancy in MENAP and CCA Countries

Victor Sanchez, Undergraduate student, Political Science; David Carleton (Faculty sponsor)
Political Science

Life expectancy is often used as an indicator to measure the social development of a country. The MENAP (Middle East, North Africa, Afghanistan, and Pakistan) and CCA (Caucasus and Central Asia) regions offer a staggering 21.8 year range in life expectancy in 2014, indicating that it is important to gain an understanding of what determinants are influencing life expectancy in these regions. This quantitative study utilizes both bivariate regression and multivariate regression analysis to determine the level of association that each independent variable has on life expectancy. The hypothesized determinants of life expectancy include various economic and social issues. While this study is not comprehensive, the goal is to identify any negative factors, furthering the knowledge and understanding of life expectancy, particularly in the area of social sciences, in the MENAP and CCA regions. If one were to correctly determine the factors that influence life expectancy, effective policies could be produced that reduce or eliminate those factors that have a negative impact, improving human development in the regions that need it the most.

Indoor Localization with Fingerprinting using Artificial Neural Networks

Delkhaz Ibrahim, Undergraduate student, Computer Science; Mubarek Mohammed, Undergraduate student, Engineering Technology; Lei Miao (Faculty sponsor) Engineering Technology

Indoor localization has not seen success, due to the inaccurate nature of GPS when used indoors. Popularity of mobile devices over the recent years has led to many potential applications regarding using Received Signal Strength (RSS) of Wi-Fi signals and “fingerprinting” database for indoor localization. The RSS values on the reference device and the target device are not identical, resulting in localization errors. To reduce the errors, a costly and time consuming calibration process could be utilized. Our method of normalization relies on the Calibration Free LOCalization (CAFLOC) approach that utilizes relative RSS information to locate target devices and does not require any calibration.

In a previous research supported by URECA, the K nearest neighbor algorithm (KNN) was implemented. What is used to replace the nearest neighbor in this project is an Artificial Neural Network (ANN), capable of consuming the fingerprinting dataset and overtime learning to identify the location of a smartphone user in the building. ANNs take a different approach to problem solving compared with conventional algorithms: they process information in a similar way to how the human brain works, and the network is composed of many highly-interconnected processing neurons working in parallel to solve a specific problem. ANN learn by example, rather than being programmed specifically for a task. In ideal situations CAFLOC has proven it is able to precisely identify locations without errors. To verify its performance in real-world scenarios, we will run extensive localization tests on CAFLOC and the ANN approach.

Factors that Cause the Leaching of Bisphenol A From Plastic Containers

Emily Jookar, Undergraduate student, Biology; Beng Guat Ooi, Faculty, Chemistry; Beng Guat Ooi (Faculty sponsor) Chemistry

Bisphenol A (BPA), which is commonly found in plastic products including food and beverage containers, is an endocrine-disrupting chemical (EDC). BPA also causes cell proliferation and affects adipogenesis. It targets receptors for estrogens, androgens, thyroid glands, and other estrogen-related receptors. BPA is metabolized in humans and rodents to glucuronide that has no known biological activity and is removed from the body within one to three days of exposure. It is still important to investigate how much BPA leaches out of plastic food containers as well as to document the conditions that may accelerate the leaching processes. My research aims to detect BPA in bottled water using the gas chromatography coupled with the mass spectrometry (GC-MS). Bottled water samples from different store brands are kept at different temperatures before being analyzed by GC-MS. The effects of pH and microwave irradiation on the leaching of BPA from the plastic containers are also studied.

A Tale of Two Series: Even and Odd Unsymmetrical Bispyridinium [*closo*-B₁₀H₁₀]²⁻ Derivatives

Anas Hajhusein, Undergraduate student, Chemistry; Loay Abuzahra, Undergraduate student, Chemistry; Muhammad Ali, Undergraduate student, Chemistry; Andrienne Friedli, Faculty, Chemistry; Piotr Kaszynski, Faculty, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

Liquid crystals (LCs) are electroactive materials found in display screens. LCs have at least one additional phase between the ordinary solid and liquid phases. Highly polar LCs often have more organized phases due to strong intermolecular attractive forces. They can exhibit two dimensionally organized smectic phases, or melt to a nematic phase that is organized in one dimension before finally becoming an ordinary liquid. A symmetrically substituted series of highly polar derivatives of boron *closo* clusters, 1,10-2(4-OC_nH_{2n+1}C₅H₄N)] compounds **1[n]** n=6, 8-12, 14, 16, 18 show two to five phases. Here we report the synthesis of unsymmetrical series [*closo*-B₁₀H₈-1-(4-OC_nH_{2n+1}C₅H₄N)-10-(4-OC_mH_{2m+1}C₅H₄N)] **2[n,m]** starting from [*closo*-B₁₀H₁₀]²⁻[2Pr₄N]⁺ (**3**). Using a literature procedure, **3** was converted to [*closo*-B₁₀H₉-1-IPh]⁻ (**4**) in a 65% yield. This key intermediate was heated with a 4-alkoxypyridine **5[n]** to give the desired pyridinium salt **6[n]**. The odd series was synthesized from **5[9]**, to give [*closo*-B₁₀H₉-1-(4-OC₉H₁₉C₅H₄N)]⁻ (**6[9]**). Next, the compound will be substituted with a 10-iodophenyl group, and treated separately with odd **5[n]**, n=5, 7, 11, and 13 to the give odd series **2[9, m]**, m=5, 7, 11, 13. The even series will be synthesized using intermediate **6[12]** obtained in an analogous series of reactions to give **2[12,m]**, m = 8, 10, 14, 16. Characterization of the LC phases of the odd and even compounds in the **2[n,m]** series using Differential Scanning Calorimetry (DSC) will allow a comparison of their liquid crystalline properties with the symmetrical series **1[n]**.

Synthesis of Reverse Amide Analogs of Cyclopropyl Peptidomimetics as BACE Inhibitors

Mahmuda Akter, Undergraduate student, Chemistry; Norma Dunlap, Faculty, Chemistry; Norma Dunlap (Faculty sponsor) Chemistry

Alzheimer's disease (AD) is a chronic neurodegenerative disease which affects the cognitive abilities of individuals resulting in gradual decline in cognition, memory, and changes in behavior leading to death. AD is responsible for > 90,000 deaths per year and is the fifth leading cause of death in Americans age ≥ 65 years. One of the most dominant theories for explaining the pathogenesis of AD is the amyloid cascade hypothesis. Based on the amyloid hypothesis, inhibition of BACE 1 protease which is considered to be primarily responsible for the cleavage of Amyloid Precursor Protein leading to the formation of A β plaques have been a potential therapeutic approach. Our laboratory has attempted to synthesize peptidomimetic BACE 1 inhibitors with a cyclopropyl core. While an effective route has been developed for a series of amides, there were difficulties in synthesizing compounds with a reverse amide. Hence, we have used synthetic routes developed in this lab to successfully design a new scheme in order to synthesize analogs of cyclopropyl peptidomimetic with the isophthalamide side chain and a reverse amide.

Analyzing Student Understanding of Isomorphism

Marilyn Kelley, Undergraduate student, Mathematics; Jennifer Lovett (Faculty sponsor)
Mathematics

This research possesses two primary goals: to achieve an in-depth personal knowledge of isomorphism and to gain knowledge of student understanding of isomorphism as it is introduced in an upper-level university mathematics course. A strong comprehension of isomorphism can equip students to successfully study group theory and other theoretical mathematics topics. However, understanding the concept of isomorphism is often difficult for students because it builds upon multiple other concepts in mathematics. This causes teaching the concept of isomorphism to be a difficult task as well. The purpose of this study is to describe how students develop an understanding of isomorphism in hopes to improve the quality and effectiveness of undergraduate mathematics education. To prepare to analyze students' understanding of isomorphism, I completed a thorough, individual study of isomorphism under the direction of Dr. James Hart. This included researching the historical groundings of isomorphism and proving several key theorems that lead up to the concept of isomorphism. I am conducting an ongoing study in Dr. James Hart's Abstract Algebra course as he utilizes the constructivist approach to introduce students to the concept of isomorphism. In class-assignments, homework assignments, quizzes, exams, and audio recordings of class and small-group discussions were collected from the Fall 2017 Abstract Algebra course. Additional data will be collected from the Spring 2018 Abstract Algebra course. To describe students' understandings of isomorphism, data will be analyzed qualitatively, open-coding for the different aspects of isomorphism. These codes will help form themes of students' understandings. This research will conclude in implications for how instructors should utilize the constructivist approach to teach isomorphism in the future.

Fungal Endophytes in *Vitis aestivalis* 'Norton/Cynthiana' Grapes of Missouri and Tennessee are Likely Distinct

Ross Thomas, Undergraduate student, Biology; Zachary Lay, Undergraduate student, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

Fungal endophytes can provide their hosts with unique characteristics. It was hypothesized that one or more fungal endophytes might be responsible, at least in part, for the drought-resistance in the Norton/Cynthiana' variety of grape (*Vitis aestivalis*). The goals of the research project were to 1) identify fungal endophytes in the grape growing in Missouri and 2) determine whether they are the same or different than those growing in middle Tennessee. To accomplish these goals, *V. aestivalis* leaf and stem tissue from Missouri were sectioned onto fungal growth plates and the fungi allowed to grow. Each visually and microscopically different filamentous fungus was isolated and cultured to purity; twelve isolates were then chosen for further identification. Genomic DNA was isolated and polymerase chain reaction was used to amplify the fungal ITS barcode region. Three different DNA fragment size results suggested the presence of at least three different species. These DNA fragments were then sequenced and BLAST was used to search the non-redundant DNA database at the National Center for Biotechnology Information for identical sequences. Four different genus were identified, including *Alternaria*, *Trametes*, *Aurobasidium*, and an unknown fungus. Some of these were identified with >99.5% probability to the species level, such as *Alternaria tenuissima*, *Alternaria alternata*, and *Trametes versicolor*. Of these twelve isolates identified from Missouri grapes, none were found in common with twelve fungi identified from Tennessee grapes using the same method. This suggests that the fungal endophyte(s) may indeed be geographic-specific.

Factors That Explain the Variance in Corruption: A Cross-National Study

Samuel Musili, Undergraduate student, Political Science; Stephen Morris (Faculty sponsor)
Political Science

The purpose of this research is to find causes or factors that help to explain why some countries are perceived to have higher corruption rates than others. For the purpose of this study, corruption is defined as the misuse of public office for private gain. Corruption is an issue that has been studied by many different disciplines because it deals with history, culture, morals, politics and economics among other things. The sample in this research consists of 30 countries chosen based on the fact that they vary in size, location, language, and government type among other factors. Every region is represented in the sample countries and they vary in the level of development as well. The study utilizes the 2016 Corruption Perception Index (CPI), which assigns countries a score ranging from 0 (highly corrupt) to 100 (very clean) based on perceived corruption in the public sector of each country. One argument finds support from this research. Countries that consistently have a high GDP per capita have lower levels of perceived corruption compared to countries that consistently have a low GDP per capita.

Opposites Attract: Donor-Pi-Acceptor Dyes in the Solid State

Tegan Schafer, Undergraduate student, Chemistry; Jakub Wojciechowski, Visiting scholar, Technical University of Lodz, Poland, Chemistry; Irina Novozhilova, Staff, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

Donor-pi-acceptor compounds have been widely investigated as nonlinear optical materials and dyes. The class of compounds exhibits a small HOMO-LUMO gap that results in a charge transfer band in the UV/vis region. The dyes have rich colors that shift with polarity of the solution with positive solvatochromism. The crystalline state provides an environment where the highly polar molecules interact with each other. Bond lengths and angles as determined by X-ray analysis provide insight into bond length alternation typically observed in these compounds. Our group has a long history of synthesizing donor-pi-acceptor dyes with aromatic amine donors and barbituric acid, tricyanofuran, and rhodanine acceptors separated by pi bridges. In this presentation, we report on a literature search for compounds in this class that have been characterized by X-ray analysis. We also provide X-ray bond lengths and angles for some new compounds made in our lab and compare with literature values for related compounds.

A Comparative Study of the Impacts of Two Active Learning Methods in High School Biology

Dakota Demarest, Undergraduate student, Biology; Naili Huszainey, Undergraduate student, Biology; Grant Gardner (Faculty sponsor) Biology

The focus of this research was to compare two evidence-based instructional strategies (EBIS), Peer Instruction (PI) and Process-Oriented Guided Inquiry Learning (POGIL), in high school biology settings. The study attempted to identify which EBIS, originally tested in postsecondary settings, was most effective in promoting active student learning about cells and heredity (Standards 1 and 4 in the Tennessee state high school biology standards). These strategies have been empirically shown to be effective in postsecondary settings numerous times. Researchers know little about their efficacy in high school classrooms and we explored the importance of this context on student learning of biology. This proposal focuses on the following research questions: 1. What changes occur in participants' knowledge of biology following instruction utilizing PI and POGIL? 2. What changes occur in participants' expert-like thinking related to biology following instruction utilizing PI and POGIL? 3. Are there significant differences in student's knowledge of biology and expert-like thinking related to biology when taught using PI or POGIL? The project involved a pre-post quasi-experimental design. A sample of high school biology students ($n = 454$) from 13 central Tennessee school districts took a pre- and post-assessment that measured: 1) their current knowledge of cells and heredity using a concept inventory, and 2) their expert-like thinking related to biology using the Colorado Learning Attitudes about Science Survey - Biology (CLASS-Bio). Between the assessment instructors taught concepts in cells and heredity using either PI or POGIL, depending on their assignment. Using paired-sample t-tests and repeated-measures ANOVA, results demonstrated a significant increase in student knowledge in the POGIL treatment as compared to the PI treatment and a similar reduction in expert-like thinking across both treatments. Results are discussed in the context of implications for high school biology instruction.

Development and Design of New Activities for Environmental Science Education

Rachel Marlin, Undergraduate student, Chemistry; Dr. Judith Iriarte-Gross, Faculty, Chemistry;
Dr. Judith Iriarte-Gross (Faculty sponsor) Chemistry

My URECA project concentrates on how MTSU students learn introductory chemistry with a focus on skills needed for the STEM professional. I have created four activities which include specific skills such as conversions, identification of patterns, and analysis of data. I am using the SALG, Student Assessment of Learning Gains, to understand how students learn best and how students respond to civic engagement activities. SALG is an assessment recommended by SENCER, Science Education for New Civic Engagement and Responsibilities (www.sencer.net). SENCER links science and civic engagement by teaching and applying unresolved civic issues to the basic sciences such as introductory chemistry. The SENCER philosophy is also one that is ideal for the MTSU MT Engage program.

Students complete a pre- and post-SALG for each activity throughout the semester. I am able to collect data from students both before they learn the content and after they complete the activity. The SALG also allows me to analyze the data once the survey is closed. SALG surveys are used in countless classes across the United States and can be tailored to a specific topic or class. Information about the SALG can be found at <http://sencer.net/assessment/#SALG>. Over this semester, I am collecting data from four activities on the following topics: food and energy, recycling, water filtration, as well as an UV radiation activity. However, at this halfway point in the semester, my data will be focused on the food and energy and the recycling activities. Results will be posted and discussed.

Is There a Distinction Between Out-Loud and Silent Self-Talk?

Derrick Collins, Undergraduate student, Psychology; Thomas Brinthaup (Faculty sponsor)
Psychology

This study focuses on whether one's use of self talk varies in regard to the situation. More specifically, it asks if there are situations in which individuals tend to use out loud self talk more than silent self talk and *vice versa*. I am using an online survey with four blocks of sixteen items that ask participants to indicate their use of self talk in different situations with the four relevant factors being self-criticism, self-reinforcement, self-management, and social assessment. Baciu, Rubin, Decorps, and Segebarth (1999) found a high correlation between the areas of the brain activated during overt self talk and those involved with covert self talk. This may indicate that the process and function of self talk is the same whether out-loud or silent. It may be that the only difference is the social dimension. Therefore, the survey should find that participants report silent self talk and out loud self talk equally in most situations, and any difference in their use would be that silent self talk will be reported more often due to social inhibition. I have thus far gathered over 140 participants for the online survey. Finding the actual distinction between the use of out loud and silent self talk, if there is any, will help researchers in the future as they investigate the differences in self talk among other dimensions, such as its valence, or investigate differences in regard to its use based on personality traits.

RPN-6.2: A Protein Required for Proteasome Assembly, May be Regulated via Alternative Promoter Usage as well as Alternative Splicing in Nematodes During Salt Stress

Robert Owen, Undergraduate student, Biology; Sara Moore, Undergraduate student, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor)
Biology

Cellular processes that regulate the manufacture, maintenance, and degradation of proteins, are important to maintaining cell and tissue function. Proteins that are damaged or targeted for destruction are degraded by the proteasome, a multi-subunit enzyme. RPN-6.2 is a protein that is part of the proteasome and is required for proteasome assembly. Thus, RPN-6.2 function could play a role regulating proteasome function. The purpose of this project was to investigate whether RPN-6.2 function or level is regulated via alternative promoter usage and/or alternative splicing in the model organism *C. elegans* under stress conditions. RPN-6.2 is encoded by a gene with two putative promoters that generate mRNAs with different 5' untranslated regions, which may regulate RNA decay. To conduct the study, RNA was extracted and cDNAs produced from wild-type worms that were salt-stressed or not. These cDNAs were used in isoform-specific polymerase chain reaction and fragments fractionated using electrophoresis to determine sizes. The six-exon reference sequence was observed in all samples showing the upstream (P1), and possibly the downstream promoter (P2), were used in both control and stressed worms. Stress-specific splicing was observed that was specific to the promoter. Control conditions showed evidence of promoter 1 usage with intron 1 inclusion, as well as promoter 2 usage with intron 2 inclusion. Stressed conditions showed evidence of promoter 2 usage with inclusion of introns 3 through 6. All intron inclusions produce truncated proteins, so regulation may occur exclusively at the RNA level to produce nonfunctional proteins rather than producing RNAs that encode proteins with altered function.

Examining the Effects of Manipulating Chaperone-Mediated Autophagy on Stress Induced Nuclear Granules (“SINGs”) within the Nucleus of Oocytes of *Caenorhabditis elegans*.

Robert Owen, Undergraduate student, Biology; Lynn Boyd, Faculty, Biology; Lynn Boyd (Faculty sponsor) Biology

Proteostasis is the cyclical protein quality control system of biological organisms. The cycle begins with protein synthesis, followed by specific regulated function within the cell and tissues, and then degradation unto the cycle repeating. Degradation allows for obsolete proteins (*e.g.* no longer used, damaged, or misfolded proteins) to be broken down into reusable amino acid and polypeptide subunits. This degradation process occurs through two main systems: 1. the Ubiquitin-Proteasome System; and 2. Lysosomes through a process called Chaperone-Mediated Autophagy. The purpose of this study was to examine the effects of manipulating Chaperone-Mediated Autophagy on Stress Induced Nuclear Granules (“SINGs”) within the nucleus of the oocytes of *Caenorhabditis elegans*. RNAi (RNA interference) was used to separately knockdown the activity of two genes that code for LAMP-1 and LAMP-2A (*Imp-1* and *Imp-2* in *C. elegans* respectively), which are the receptor proteins of lysosomes responsible for binding to the chaperone-substrate misfolded protein complex and translocating it across the lysosomal membrane for subsequent degradation. With the translational activity reduced of either the *Lamp-1* gene or the *Lamp-2A* gene, the process of lysosomal Chaperone-Mediated Autophagy was halted and caused a buildup of misfolded proteins in the cytoplasm. An increase of SING formation was then observed during salt stress conditions in the RNAi knockdown models compared to the control models. Two possibilities for this increase include: 1. Cytoplasmic misfolded proteins are inherently included in SING formation; or 2. An increase in cytoplasmic misfolded proteins triggers a chaperone sink in the cytoplasm which partially hinders normal chaperone function in the nucleus.

Word Learning in Authentic versus Explicit Contexts

Janie Kullmar, Undergraduate student, Health and Human Performance; Kathryn Blankenship, Faculty, Health and Human Performance; Kathryn Blankenship (Faculty sponsor) Health and Human Performance

The wide scope of practice and the complexity associated with the field of speech-language pathology require students to understand concepts from a wide variety of areas. This is seen in the standards for certification where applicants must display "knowledge of basic human communication and swallowing processes, including the appropriate biological, neurological, acoustic, psychological, developmental, and linguistic and cultural bases..." (Council for Clinical Certification in Audiology and Speech-Language Pathology [CFCC], 2016, n.p.). Professors of speech-language pathology are tasked with teaching novel words in every class. One of the most valuable tools available is the textbook which aims to provide information to students and can be used in a variety of ways. This study aims to explore its effectiveness for learning new vocabulary and an introduction to the material. The researchers compared the effectiveness of a vocabulary list (i.e., explicit environment) to a textbook passage (i.e., authentic environment) for the initial exposure of domain-specific vocabulary from an anatomy textbook. This was posited as a superior form of introduction to complex material for students who struggle with the complex language of textbooks. The participants were college students majoring in speech-language pathology and audiology. The gain scores between groups were similar, and this was true of students with both high and low reading abilities, as measured by the reading score from the American College Testing (ACT). Student performance was highly variable, and many students performed poorly. This poor performance may be related to research design or student reading habits in general.

Observing the Solar System with Software Defined Radio

John Jackson, Undergraduate student, Physics and Astronomy; Chuck Higgins (Faculty sponsor)
Physics and Astronomy

Radio Astronomy provides an avenue to study the universe by seeing what the eyes cannot. The technology used in current Radio observations face the common dilemma of cost versus performance. Recent developments in radio technology has provided a new and exciting alternative called Software Defined Radio. Software Defined Radio (SDR) is a powerful tool that can potentially replace expensive specialized hardware for a fraction of the cost. These devices, however, are still largely untested in the field of Radio Astronomy. By exploring the potential of SDRs and comparing their performance with current standard devices, a Radio Jove receiver and a radio spectrograph, the quality and limitations of the data they provide is better understood. While SDR devices do present an enormous potential to the field of Radio Astronomy, the ability to perform sound observations at reasonable costs is also of great interest to science educators, amateur scientists, and community science organizations.

Effect of the Lunar Shadow in the Intake of Data from Solar Activity

Beverly Warner, Undergraduate student, Physics and Astronomy; Charles Higgins (Faculty sponsor) Physics and Astronomy

At the heart of my research, I identify and gather data from the Radio Jove Archive; this is a program that is run by NASA that encourages “citizen scientists” to be active in physics and astronomy research. Due to the approach of the solar eclipse of 2017, the question was proposed to find whether the presence of the lunar shadow affected the recorded solar bursts’ amplitude in temperature. This solar eclipse presented a unique opportunity for radio astronomy; it allowed for multiple radio observing stations to record data from this event across the United States. Using multiple radio telescope data from differing sites, I plot spectrograph and single frequency data with similar scales for comparison purposes. The time frame for comparison data include days leading up to, days after, and the day of the solar eclipse of 2017. Analyzing the two types of data from several reliable sites, I identify and compare single solar bursts over a span of five hours. To be able to automate the process of plotting the average burst count and intensity, I am currently writing a computer code in Python, helping to compare our collected data with the known spacecraft data. Once we have interpreted the data, comparing stations within totality and those outside of totality, we will determine if the lunar shadow had an effect on an observing station during the eclipse. Documenting the changes caused by the lunar shadow will also present the possibility of further study into discovering the changes in the ionospheric plasma and how electromagnetic waves propagate through it.

Identification of Fungal Endophytes in *Vitis aestivalis* 'Norton/Cynthiana' Grapes of Middle Tennessee

Rachel Bailey, Undergraduate student, Biology; Nolan Jolley, Undergraduate student, Agribusiness and Agriscience; John Dubois, Faculty, Biology; Tony Johnston, Faculty, Agribusiness and Agriscience; Rebecca Seipelt-Theimann (Faculty sponsor) Biology

Vitis aestivalis 'Norton/Cynthiana' is a desirable grapevine due to its grape quality, resilience, and reduced acidity. Electron microscopy has shown that 'Norton/Cynthiana' has at least one fungal endophyte growing within its tissue. Fungal endophytes have been known to confer special characteristics to plants, suggesting that the endophyte may contribute to the grape's unique characteristics. To begin identification of the endophyte(s) specific to grapes grown in middle Tennessee, tissue was collected from leaf and stem cuttings, surface sterilized, and placed on fungal growth medium. Fungi that grew as filamentous fungi, were confirmed visually and microscopically. A sample of twelve pure cultures were then grown and used for genomic DNA isolation. Polymerase chain reaction was then used on purified DNA to amplify the fungal ITS barcode region which is generally used for fungal DNA identification. DNA fragments of at least five different sizes indicated potential for at least five different putative endophytes. DNA fragments were sequenced and BLAST was used to search the National Center for Biotechnology Information non-redundant DNA database for DNA matches. Eight different species of fungi, including *Fusarium* and *Colletotrichum* were identified and are currently the basis of further research.

Evaluating the Role of Memory in Cell Cycle Progression

John Ford, Undergraduate student, Computer Science; Jasmin Laurel, Undergraduate student, Biology; Rachel Leander, Faculty, Mathematics; Christian Devine, Undergraduate student, Biology; Rachel Leander (Faculty sponsor) Mathematics

To replicate, cells must progress through the cell cycle. Regulation of the cell cycle is a topic of interest to biological researchers, since it is necessary to prevent unhealthy proliferation, as found in cancer. Cell cycle progression is known to be highly variable, and experimental work has shown that the majority of this variability is sourced from the G1 growth phase. Moreover, recent research [Yang, Chung, Kudo, and Meyer. Competing memories of mitogen and p53 signaling control cell-cycle entry. *Nature*. 2017; 549: 404-408.] suggests that “memories” of mitotic signaling are a major source of variability. A model, which explains cell cycle variability as a bifurcation in which select cells bypass a part of G1 in response to inherited memories, has been proposed. Alongside experimental research, mathematical models can be useful in elucidating the principles that govern cell cycle control. In this work, we use drift-diffusion stochastic differential equations to describe the process through which cells acquire the growth factors they need to complete the G1 growth phase and advance toward mitosis. Within this modeling framework, we develop alternative models for describing the impact of memory on cell cycle progression. The models are evaluated based on their ability to describe important features of individual-cell data, in order to form hypotheses about the mechanisms through which memory influences cell cycle progression.

Narrative Discourse Performance in Older Adults

Natalie Foulks, Undergraduate student, Health and Human Performance; Kathryn Blankenship (Faculty sponsor) Health and Human Performance

This study examined the narrative performance in elderly individuals on two narrative tasks using personal and pictorial stimuli. The quality of narratives produced by typically and atypically (*i.e.* a stroke or Parkinson's disease) aging elderly were compared as well as the quality of narratives produced by the personal stimulus and the pictorial stimulus. The narratives were examined on the total number of T-units used, use of cohesive ties, narrative relevancy, total dysfluencies, and lexical diversity. This study found that there were significant differences in the quality of narratives when produced from different stimuli and from elderly individuals of different ages. Also, this study showed that there are significant differences in narrative discourse performance in atypically aging adults compared to typically aging adult. The findings of this study provide information regarding the characteristics of narratives produced by individuals at different stages of the aging process on two narrative tasks and will be helpful to practicing speech-language pathologists when treating atypically aging individuals.

Dimensional Attention Learning for Working Memory

Bishoy Bektor, Undergraduate student, Computer Science; Joshua Phillips (Faculty sponsor)
Computer Science

Implementing a dimensional attention filter is an important step in the process of introducing a more biologically plausible attention filtering system in the Working Memory Toolkit (WMtk) software library. The WMtk currently requires the user to preemptively filter out candidates for the working memory slots that are present. However, for the working memory model to be biologically plausible, it must be able to filter through distractors passed into the working memory slots, since the ability to filter out information not needed for the task is an important facet of human working memory. The dimensional attention filter was built using separate, task appropriate weights for each relevant dimension to completion of the task (both distractors and nondistractors). This attention filter will be used in a red-green task switching test that requires an agent to learn to remember one of two colors displayed at the beginning of a task which is predictive of the task goal. It should learn to use this information to solve the given task even if the working memory slot is passed distractors such as irrelevant state information. The results show that the dimensional attention filter aided in the learning of the task more efficiently, taking less time steps on average than the model without the dimensional filter, and created a smoother value function for the task.

Synthesis and Characterization of Antifungal Peptoids against *Cryptococcus* by Means of Structure Activity Relationship

Madyson Middleton, Undergraduate student, Chemistry; Kevin Bicker (Faculty sponsor)
Chemistry

The impending rise in antimicrobial resistance has necessitated alternative therapeutic options for resistant pathogens such as *Cryptococcus neoformans*. Prior work in this lab identified the peptoid AEC5 as a potent antifungal against *C. neoformans*. Our primary goal is to optimize the therapeutic potential of AEC5 through Structure Activity Relationship studies by altering the three positions of this peptoid in three rounds of SAR. Round one found the tridecyl and farnesyl tails to be of potential. These tails carried over into round two, where the tridecyl tail was determined as the more promising derivative, particularly when coupled with the sub-monomer thiophene at position three (SA6), which was determined to be the optimal aromatic heterocycle in this position. We are now entering round three where the second position of the peptoid will be altered in hopes of further improving antifungal potency while mitigating mammalian cell toxicity. The production of an improved antifungal compound from the SAR could offer more and/or better therapeutic options for patients suffering from *Cryptococcus neoformans* infections.

Pros & Cons Of Clickbait With Social Media

Makayla Stout, Undergraduate student, English; Kayla Chu, Undergraduate student, English; Sandra Cavender (Faculty sponsor) English

Our project is based off the information about Click bait and Social Media. These two fit right in with each other because Click bait is sometimes the most interesting things on social media websites. Most people only get on social media to be entertained and that's even when the news is true or untrue. On the poster we talked about how some sites are trying to stop so much click bait by getting people to report it more. We also talked about the pros and cons of click bait being on social media. A few pros are as followed: Easy access to audience and sellers, a good way to promote businesses or products and it is very eye catching at times. These are all good ways of using click bait, but of course there are few of them and more disadvantages so the bad is going to be talked about more. We as people just have to pay attention more and do what's right when it comes down to inappropriate and illegal things being put on social media.

Symmetrical Bis-(4-Alkoxy pyridinium) Liquid Crystals Made from Boron Clusters

Muhammad Osama Ali, Undergraduate student, Chemistry; Andrienne Friedli (Faculty sponsor)
Chemistry

Substitution of *closo*-borate anions with onium fragments leads to highly polar or quadrupolar derivatives that are of fundamental interest and for electrooptical applications. Symmetrical substitution of the [*closo*-B₁₀H₁₀]²⁻ and [*closo*-B₁₂H₁₂]²⁻ clusters with 4-alkoxy pyridinium fragments yielded highly fluorescent quadrupolar liquid crystalline derivatives. The [*closo*-B₁₀H₈-1,10-2(4-OC_nH_{2n+1} C₅H₄N)], **1[n]**, n= 6-12, 14, 16, 18 products were synthesized in 55-60% yield. The dodecaborate cluster formed two isomers: the [*closo*-B₁₂H₁₂-1,12-2(4-OC_nH_{2n+1} C₅H₄N)], **2[n]** n = 7, 9, 11 and [*closo*-B₁₂H₁₀-1-(4-OC_nH_{2n+1} C₅H₄N)-10-(4-OC_nH_{2n+1} C₅H₄N)], **3[n]**, n = 7, 9, 11 in about 15% and 8% yields respectively. Thermal analysis of **2[n]** revealed that the series of compounds exhibited nematic phases along with relatively high melting points as compared to **1[n]**. An in-depth analysis of **1[n]** through polarized optical, thermal and powder X-ray diffraction (P-XRD) analysis revealed the formation of a nematic phase and several highly organized smectic phases as the length of the terminal alkoxy chain increased. The nematic phase was replaced by a smectic phase for n > 14. Formation of these phases was shown to be driven mainly by dipolar interactions. The solid-state structure of **1[8]** was also established by a single crystal SCXRD.

Rigid Body Guidance in Three Dimensions

Matthew Radice, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

Automation is used in industrial settings to move products and material around the factory floor. The machines used in industry come with high initial costs, large physical footprints, and require constant maintenance. As automation grows, industry will be looking for cost effective ways to move products and materials from place to place quickly and efficiently. Finding an alternative solution that address these areas will lead to lower costs, smaller physical footprints, and maintenance free operation. Rigid body guidance uses constraints built directly into the design to guide the movement of a mechanism in a chosen path. This research focuses on these constraints, utilizing them to guide a mechanism in a desired trajectory. This system will contain 8 ball and socket joints that will be driven by two motors. There will be four joints on the base and four joints on the upper platform. This will allow the platform trajectory to be controlled by the two motors and only be restricted by the limits of the joints. The outcome of this research will produce a less complex machine that will address cost, size, and maintenance.

Limestone Powder: The Concrete Industry's Answer for the Fly Ash Shortage

Lauren Clodfelter, Undergraduate student, Concrete Industry Management; Jonathan Huddleston (Faculty sponsor) Concrete Industry Management

The economic demand for fly ash in concrete has grown more prevalent in each of the decades since it was first introduced in concrete in the 1940's. Fly ash, a byproduct of coal fired power plants, can be used in concrete mixes to reduce portland cement, which in turn reduces the overall cost of the concrete mix. However, due to the current political climate, environmental concerns, and societal view of fossil fuels, the waste product that the concrete industry has grown so dependent on is projected to run out in the next two decades. Therefore, producers are hastened to find the next economical cement replacement to continue concrete's reign as the most versatile, economical, and ubiquitous building product in modern construction.

To solve this looming shortage, students in the Concrete Industry Management (CIM) program at Middle Tennessee State University are researching limestone powder as the possible solution. Limestone Powder is a byproduct of crushing limestone for a multitude of construction projects. Previous research has shown that limestone replacement in blended cements has little or no negative impact on compressive strength or set time. However, these replacements have only been looked at in small percentages and not in the typical range of twenty-five to fifty percent that we see with fly ash.

Currently, CIM students are researching high percentage limestone powder replacements at twenty-five and fifty percent, as well as limestone powder combined with slag which is a byproduct of smelting ore. This research seeks to prove limestone powder's usefulness as a new green substitute for portland cement while maintaining concrete strength, durability and workability.

Making Comprehensible Health Information Accessible and Entertaining for Parents with Low Literacy Levels

Maeve Bleistein, Undergraduate student, Psychology; Matthew Hackett, Undergraduate student, Psychology; Stuart Bernstein (Faculty sponsor) Psychology

There is a lack of access to comprehensible health information for parents with low literacy skills, which contributes to a high usage of the emergency room for issues that could be treated at home. Previous studies show that providing comprehensible information, as well as training for how to use it, decreases this unnecessary emergency room usage. However, researchers have an equally difficult time reaching this demographic of parents, as lengthy in-person training interventions are unappealing to participants, and online training methods require sustained attention to a potentially dull task. When administered in the past, both methods of literacy training reported low attendance and low completion rates. In order to improve accessibility, we modified the original online training into a shortened edition to run on kiosks in waiting rooms at health clinics and health fairs. For the purposes of keeping participants' attention, the training's design is that of a survival-themed video game. For the pilot data, we gave participants easy-to-read health manuals, administered the training, and then measured the accuracy of the participant's results. Pilot data results showed that, after the training, significantly fewer participants reported they would take their children to the E.R for common medical issues they could treat at home, like fevers, coughs, and vomiting. Participants who received the training were also more accurate in their answers and reported themselves as more confident than the control group, who answered the same questions without any prior training. This shortened survey, combined with an incentive of receiving a free easy-to-read health manual upon completion, could attract participants who lack time and motivation to participate fully in other methods of health literacy training.

A Freshman's Journey: An Italian Travel Memoir

Madeleine Kurtz, Undergraduate student, English; Philip Phillips (Faculty sponsor) Honors College

My thesis is a creative project recounting my experiences studying abroad in Italy. Within the work are my personal reflections and exposure to Italian culture, art, and literature as I experience a whirlwind journey of thirteen days up and down the Italian peninsula. The work is divided into fifteen parts, including a prologue and epilogue, with thirteen chapters in between cataloguing each day in Italy. Also included are my own hand-drawn illustrations of various events and cultural landmarks. The work depicts my personal growth and impressions as a first-time traveler abroad as well as my critical interactions with key texts that informed my experiences and continue to influence my worldview. The poster presentation will include excerpts of my writing, illustrations, and photographs, which express the themes in the creative project.

Implicit Learning Differences Between Dyslexics and Neurotypicals

Caitlin Ketcham, Undergraduate student, Psychology; Haylie Stoltz, Undergraduate student, Psychology; Andrew Towle, Undergraduate student, Psychology; Stuart Bernstein, Faculty, Psychology; Stuart Bernstein (Faculty sponsor) Psychology

Our experiment examined whether the broad differences in habituation to spoken and printed words observed in adults with dyslexia extends to implicit learning and habituation to noise. Adult college students with a broad range of reading abilities ($n = 75$) first completed a reading assessment battery. Participants were categorized by diagnosis of compensated dyslexic, dyslexic (not compensated), garden-variety poor reader, and average reader based on their scores from the WRMT-III and TOWRE-2 subtests. Implicit learning of non-verbal sequences was assessed with a Pokemon-themed go-no-go task. The pattern of the go-no-go task included 6 possible positions for the no-go stimulus (Feraligator), with the Feraligator appearing only on the 2nd, 4th, and 6th position. The Feraligator was 33% likely to appear in the 2nd position, 50% likely in the 4th position, and 100% likely in the 6th position. The overall error pattern was significantly higher for position 2 (28% FA) than for position 4 (25% FA) and position 6 (22% FA). White noise at 70db (typical noisy classroom level) was added to the go-no-go task in half of the trial blocks to increase cognitive load, which significantly increased more false alarms (FA) because it was harder for participants to inhibit responses. These findings show the task was sensitive to individual differences in that the low achieving readers had a harder time inhibiting go responses in the 2nd position, while also struggling significantly with the 4th and 6th position. The dyslexic and typical reader groups did not experience this effect. These findings demonstrate that dyslexic individuals' deficit in implicit learning does not translate to non-verbal sequences.

New Drugs for Bad Bugs: Aurones as Novel Antifungal Agents

Mario Lorenzana-DeWitt, Undergraduate student, Chemistry; Mary Farone, Faculty, Biology; Scott Handy, Faculty, Chemistry; Zachary Taylor, Graduate student, Chemistry; Arjun Kafle, Graduate student, Chemistry; Mary Farone (Faculty sponsor) Biology

Dermatophytes are invasive fungi responsible for prevalent and reoccurring episodes of infections. These infections, known as Tinea, are difficult to treat and current drugs have low efficacy for long-term treatment. Tinea mostly manifest as superficial infections of skin, hair, and nails. *Trichophyton rubrum*, is one of the most common strains associated with dermatophytic infections and causes ringworm, jock itch and athlete's foot. *T. rubrum* accounts for the majority of Tinea infections and is becoming resistant to current antifungal treatments.

Aurones are potentially novel antifungal compounds. They are flavonoid-like derivatives, which were chosen to be tested due to their defense mechanisms against pathogens in flowers and fruits. A total of 62 synthetic aurones were screened using the Clinical Laboratory Standards Institute's M38-A2 guidelines for filamentous fungi. The different aurones were diluted in a buffered solution to which a standardized inoculum of *T. rubrum microconidia* was added, for a final aurone concentration of 100 μ M. The minimum inhibitory concentration at which at least 90% (MIC90) was then determined. At least five aurones showed inhibition percentages at 100 μ M including AA1A (99%), AA2A (99%), AA3A (93%), AK34(97%), AK35 (98%). Several other aurones also showed high levels of inhibition, such as AA3, AA4, AA5, AA6, AA7, and AA8.

After 100 μ M concentrations were screened, serial dilutions of the top five aurones were performed to determine the inhibitory concentration at 50% (IC50). These values are currently being used on a checkerboard assay with Amphotericin B to determine whether the aurone could possibly synergize with a current antifungal drug. Testing these aurones and defining their antifungal capabilities may lead to future applications in pharmaceutical research to treat the widespread problems caused by *T. rubrum* and other fungi.

Exploration of Antifungal Peptide, AEC5, for use as an Antimicrobial Therapeutic Against *Cryptococcus neoformans*

Sabrina Spicer, Undergraduate student, Chemistry; Kevin Bicker (Faculty sponsor) Chemistry, and Erin McClelland (Faculty sponsor) Biology

Background: *Cryptococcus neoformans* is a fungal pathogen that targets immunosuppressed individuals via spore inhalation. According to recent studies, 220,000 HIV/AIDS patients contract meningitis due to *Cryptococcus* each year and over 82% of these cases will be fatal. Current treatment options for *C. neoformans* infections have high toxicity and increasing drug resistance, demonstrating the dire need for new, non-toxic therapeutic developments. One known alternative to the high toxicity of current antifungals is the use of antimicrobial peptides (AMP's) for treatment, however peptides are quickly broken down in the body by proteases which makes them a poor therapeutic. A solution to this problem is the use of peptide-mimics, peptoids. Peptoids structurally vary from peptides in that the R-group is attached to the amide nitrogen as opposed to the carbonyl carbon. This small difference allows for increased in-vivo stability while maintaining low toxicity. Our lab has discovered a tripeptoid, termed AEC5, with promising therapeutic potential against *Cryptococcus neoformans*.

Methods: Current research endeavors in our lab have further characterized AEC5 as a viable treatment option for *Cryptococcus neoformans*. Studies into the mechanism of action, in-vivo half-life, and sub-chronic toxicity study have been performed.

Results: These studies indicated a 25-hour half-life of AEC5, as well as no toxicity *in-vivo*. In addition, through synergy testing we have furthered the hypothesis that AEC5 may have a mechanism of action similar to amphotericin B.

Conclusions: This research represents an important step in the development of AEC5 as a treatment option for individuals dealing with fungal infections.

Utilizing a Live Cell Reporter of M1 Macrophage Activation to Study the Effects of Plant-Derived Immunomodulatory Polysaccharides

Devyn Hayes, Undergraduate student, Biology; J. Logan Bowling, Graduate student, Biology; Rajarshi Gosh, Graduate student, Biology; Anthony Farone, Faculty, Biology; David E. Nelson, Faculty, Biology; David Nelson (Faculty sponsor) Biology

Background: Macrophages are phagocytes of the innate immune system and act as a first line of defense against pathogenic microorganisms. When naive macrophages encounter a pathogen or its ligands, they can become polarized or “activated”. Classical activation (M1) is a heightened anti-microbial state marked by increased expression of the *Nos2* gene, which encodes inducible nitric oxide synthase (iNOS). This catalyzes the production of nitric oxide (NO) from L-arginine and is used to kill ingested pathogens. While various pathogens are able to block M1 polarization of host macrophages to prevent being destroyed, some plant-derived polysaccharides are able to enhance M1 polarization and could therefore be of therapeutic use.

Methods: We have developed a fluorescent reporter to monitor *Nos2* gene expression as a reporter of M1 activation in live macrophages. The reporter is stably transduced in cultured RAW264.7 murine macrophage cells using a lentiviral vector encoding a destabilized red fluorescent protein (mCherry) under the control of the *Nos2* gene promoter. These cells were exposed to known inducers of M1 activation, such as bacterial lipopolysaccharide (LPS), or novel plant-derived polysaccharides thought to have immunomodulatory activity.

Results: Using a combination of live cell imaging and biochemical analysis, we found our reporter to faithfully match the responses of the endogenous *Nos2* gene to LPS, validating its use as an M1 reporter. We also found that the four tested plant-derived polysaccharides induced moderate expression of the mCherry reporter at 25 µg/mL doses, confirming that they are capable of affecting the polarization state of macrophages.

Conclusions: We show that our reporter can be used to measure the kinetics and magnitude of *Nos2* expression as a reporter of M1 polarization in live macrophages. We also demonstrate that the reporter can be utilized as an effective screening tool for the identification of novel compounds with immunomodulatory activity.

Fungal Endophytes of *Vitis aestivalis* Variation Cynthiana/Norton Identified from Arkansas Overlap, But Are Distinct from Those Isolated from Tennessee and Missouri Grapes

Joseph Jones, Undergraduate student, Chemistry; Kayley Stallings, Undergraduate student, Chemistry and Agribusiness and Agriscience; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology, John Dubois (Faculty sponsor) Biology, and Tony Johnston (Faculty sponsor) Agribusiness and Agriscience

Fungal endophytes have important roles in a plant's biology and can influence traits such as hardiness. The goals of this study were to identify fungal varieties found within a hardy variety of grape *Vitis aestivalis* var. Cynthiana/Norton from Arkansas and to determine if those fungi were the same or different from those found in the same species in middle Tennessee. Sections of grape leaves and stems were surfaced sterilized, cut into sections, and placed on malt extract medium. Each colony was observed micro- and macroscopically for fungal characteristics. Filamentous fungal cultures were then grown to purity; twelve isolates were selected for further analysis. DNA was extracted and used as a template for polymerase chain reaction to amplify the nuclear ribosomal internal transcribed spacer (ITS) region. All twelve samples successfully produced DNA fragments. Based on DNA sizes at least four distinct species were isolated. DNA fragments were sequenced and used with BLAST to search the non-redundant DNA database at the National Center for Biotechnology Information for matches. Eight distinct genera were identified, two of which were common to fungi isolates found in grapes from Tennessee (*Fusarium*, *Xylaria*). A further two were common to fungi isolates found in grapes from Missouri (*Alternaria* and *Aurobasidium*). Genera of two additional isolates were unique to Arkansas (*Epicoccum* and *Pestalotiopsis*). Future directions will include species identification and phenotypic characterization with the aim of investigating the fungal function inside the grape and their roles in grape hardiness.

Investigation into Timing of Cuttings for Maximum Propagation Efficiency of *Vitis aestivalis* 'Norton/Cynthiana' Grapevines

Nolan Jolley, Undergraduate student, Agribusiness and Agriscience; Tony Johnston (Faculty sponsor) Agribusiness and Agriscience

Vitis aestivalis 'Norton/Cynthiana' is a grape found as far north as southern Ontario, as far east as Maine, as far west as Oklahoma, and as far south as Florida. The goal of this research was to determine the optimal time of year and/or time after last reeze that will yield the highest propagation rate for 'Norton/Cynthiana'. Previous research determined that the best time of year to propagate was June, ten weeks after the last temperature below 0° C or eight or nine weeks after the first budding. Samples were collected weekly from a local vineyard, treated with 0.1% IBA, and placed in the plant growth room located in the MTSU Biology greenhouse. Daily high and low temperatures were recorded. After six weeks, cuttings were evaluated for root growth. Rooting success rates were highest in the month of June at 10%, 12 weeks after the last frost and 10 weeks after the first budding.

Thanatobiome Activity in Drug Overdose Cases

Emily Brackett, Undergraduate student, Forensic Science; Frank Bailey (Faculty sponsor) Biology

Postmortem interval (PMI) is an estimation of time since death determined by forensic investigators during a case. Currently, several methods can be utilized by investigators to estimate PMI, but these methods cannot give an exact time of death. Recent studies in forensic microbiology have been looking at the thanatobiome as a potential new method for PMI determination. Thanatobiome studies involve the investigation of organized changes in bacterial activity in the internal organs that happen after a person dies. The objective of this project is to investigate the thanatobiome activity of cadavers that died from illicit and abused drug overdose. Overdose drugs were extracted from liver tissue samples from 10 different cadavers of overdose victims with varying PMIs and analyzed to determine identity/concentration of the overdose chemical(s). The most common drug found was methadone. Bacterial DNA was extracted from spleen and liver samples from cadavers and the identity of the bacteria determined using next generation sequencing. These data were then used to investigate the Postmortem *Clostridium* Effect (PCE) in these criminal overdose cases. Next-generation sequencing results show that *Clostridium* was the most abundant genus found in the postmortem liver and spleen tissues.

Characterization of Oils and Oil Mixtures using Terahertz Time-Domain Spectroscopy

Seth Floyd, Undergraduate student, Physics and Astronomy; Khem Poudel, Graduate student, Computational Science; William Robertson, Faculty, Physics and Astronomy; William Robertson (Faculty sponsor) Physics and Astronomy

Terahertz time-domain spectroscopy (TDS) transmission analysis as applied to oils typically involve multi-layer sample holders of differing materials. We investigated the interference of transmission absorption through multilayer material using different holders in THz region. The sample holder consists of a milled delrin ring and two thin low-density polyethylene (LDPE) windows. This reduces the complexity of analysis and increases the accuracy of terahertz time-domain spectroscopy on oil-based samples. Further, we can analyze the refractive index and absorption coefficient for different oils. This analysis offers a new approach in monitoring of oil quality during manufacturing process and in food industry. The use of oils that are largely transparent in the THz regime also serves as a medium in which to dissolve chemicals for THz spectroscopic analysis.

Equine Temperament Examination Through Novel Object Exposure: Suitability for Equine-Assisted Activities and Therapies

Madeline McDonald, Undergraduate student, Agribusiness and Agriscience; Holly Spooner (Faculty sponsor) Agribusiness and Agriscience

Equine-assisted activities and therapies (EAAT) encompass a realm of programs designed to utilize the horse in a therapeutic capacity to help children and adults. It is important to have suitable horses for these programs, but there are no set tests to determine whether a particular mount is acceptable. Several methods were tested to see which was most suitable to determine the best horses to use for EAAT during novel object reactivity test using a mechanical cow training system (cowtracs), tarp, or fog machine. Heart rate data, live video observation, and behaviorally defined adjective (BDA) scores were recorded and compared to an instructor suitability score sheet. Results suggest that the tarp reactivity test and heart rate data are the best indicators of suitability, while the cowtracs and fog machine proved to be ineffective. It is important to use reactivity objects that the horse may encounter during its use as a therapy animal.

Project ATOM: The Audio and Touch Operations Manager for Molecular Modeling Software

James Scott, Undergraduate student, Chemistry; Preston Macdougall (Faculty sponsor)
Chemistry

Chemistry necessitates an understanding and awareness of 3-dimensional space. By utilizing visualization software such as PyMol, a researcher can see a virtual representation of molecular structures, which in turn can be used to view sites of molecular interactions and activity. As useful as these modeling programs are, they have a slight disconnect between the user and the program. There is also often a steep learning curve, leaving an unmet need to make visualization tools more interactive and user friendly. To bridge this gap, with the help of a Microsoft Kinect, ATOM allows the user to control and interact with molecular modeling software by using voice commands and gesture controls in more intuitive way. Free from the encumbrance of a mouse and keyboard, more focus can be given to the observation of the desired structure.

Assessment of Anti-Herpes Activity by *Cichorium Intybus*

Csilla Klara Szepe, Undergraduate student, Biology; Stephen Wright (Faculty sponsor) Biology

Herpes simplex virus (HSV) causes a variety of diseases which are common throughout the world and can be life threatening. As currently there is no vaccine or cure against HSV, the search for an antiviral agent is very important. In our previous work, we identified an extract of the common chicory, *Cichorium intybus*, that has good antiviral properties. The crude extract had 69% virus inhibition with less than 1% cytotoxicity at 50 μ g/mL concentration. Our current research aims to further purify the extract so that the active compound can be identified. Column chromatography provided four fractions from which only one – compound D – had suitable anti-herpes properties, demonstrating the same level as the crude extract. Compound D was further purified by Sephadex column to filter out bigger molecules (like pigment). Using Thin Layer Chromatography, we identified the active fractions of the column. Ongoing research is expected to clarify the anti-herpes properties of the active fractions as well as its composition by Nuclear Magnetic Resonance Spectroscopy. Possible mechanisms of action could then be investigated with a pure compound in its most potent concentration.

Using Linguistic Inquiry and Word Count to Examine Relationships between Personality and Writing Style

Cindi Brown, Undergraduate student, Psychology; Ying Jin, Faculty, Psychology; Thomas Brinthaupt, Faculty, Psychology; Thomas Brinthaupt (Faculty sponsor) Psychology

Prior research has found several intriguing relationships between personality factors and writing style (Hirsch & Perterson, 2009), but most studies of this type have focused on Five Factor Model personality traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism). The current study examines relationships between Myers Briggs Type Indicator personality factors (preferences between extraversion/introversion, intuition/sensing, feeling/thinking, and judging/perceiving) and writing style. Writing samples obtained from online forum posts on the Personality Café website by 462 individuals with previously determined Myers Briggs types were examined. An emotional tone score for each writing sample was generated using linguistic inquiry and word count (LIWC, Pennebaker, Francis, & Booth, 2001), a text analysis software program that “reads” writing samples and counts words reflecting different emotional and thought patterns. The average emotional tone score for Extraverts was 6.162 points higher than the average emotional tone score for Introverts [$t(455) = 3.217, p=0.001$], after controlling for the effects of intuition vs. sensing, feeling vs. thinking, and judging vs. perceiving. Additionally, Feelers were found to have an average emotional tone score 8.860 points higher than Thinkers [$t(455) = 4.627, p$

Why Are Some Countries Happier Than Others?

Miura Rempis, Undergraduate student, Political Science; David Carleton (Faculty sponsor)
Political Science

This research poster explores what factors most directly make certain countries happier than others according to the *World Happiness Report Index* (2017 edition). The research shows that out of the fourteen subsections evaluated by the *WHRI*, these categories can be simplified down to merely two or three cases that most directly relate to the happiness experienced in any given country. The cases and factors include individual countries' relationship to politics and government, the role that religion plays among the population, and the socioeconomic climate of said country. The countries evaluated include selections from the top 20 happiest countries: Norway and Denmark (ranking first and second out of 170), and the United Kingdom and the United States (ranking fifteenth and seventeenth out of 170). The results indicate that a population's relationship to politics and the role that their respective socioeconomic climate plays in the public's wellbeing more closely correlate to the overall happiness a country experiences than the role of religion does.

Inducing Somatic Embryogenesis in Grape (*Vitis aestivalis* 'Norton/Cynthiana') Callus

Hannah Hall, Undergraduate student, Biology; Aimee Wilson, Undergraduate student, Biology; Shannon Smith, Graduate student, Biology; John Dubois, Faculty, Biology; John Dubois (Faculty sponsor) Biology

Vitis aestivalis 'Norton/Cynthiana' is a hybrid wine grape that is not reliably reproduced by traditional methods. Plant tissue culture has been useful in the propagation of other *Vitis* species and unorganized callus has been successfully produced in *V. aestivalis* with the Wilson *et al.* (2016) protocol. The next step towards plantlet regeneration is inducing somatic embryogenesis from callus cultures. In this study new callus and maintained cultures were plated onto new media types containing different combinations of plant growth regulators. Tissues were taken from healthy vines and sterilized, as well as, from established callus cultures from previous sterilizations. Experimental media types contained varying levels of auxin (2,4-dichlorophenoxyacetic acid) and cytokinin (kinetin), in attempt to initiate root or shoot production. Other media types based on the MSI and PIV from Dhekney (2009). The results show that high auxin, low cytokinin and low auxin, high cytokinin media types promote healthy callus growth without the initiation of roots or shoots. MSI and PIV media types did not show any embryogenic responses and had low callus production/decreased production of healthy callus. To date, results have provided new maintenance media types and will provide new insights towards inducing somatic embryogenesis in *V. aestivalis*.

Correlation of Bentonite Beds Throughout the Carters Limestone in Williamson County, TN

Charlotte Byrd, Undergraduate student, Geosciences; Clay Harris (Faculty sponsor) Geosciences

Several well-defined volcanic ash beds of so-called bentonite occur within the Upper Carters Limestone in Middle Tennessee. Referred to as the T1-3 bentonites, these clay-rich shales are age-dated marker beds that help geologists study the stratigraphy and paleogeography of the area during the time of deposition. The T-2 & T-3 beds are easily identifiable at several outcrops in Williamson County, specifically along I-840, and correlate both temporally and spatially at all locations. However, an outcrop near mile marker 38 (MM38) on I-840 exhibits a slightly confusing sedimentary profile where all three bentonites are hard to identify. This is especially unfortunate due to the unusual range of ancient sedimentary environments preserved in the Upper Carters Limestone in Williamson County, and their lateral variability. These characteristics are pertinent to the paleogeographical study of the region, and therefore correctly identifying the T1-3 beds at this outcrop is of significant importance. To this end, clay-bearing shales found at the MM38 outcrop will be sampled and analyzed using x-ray diffraction. Their patterns will then be compared with x-ray patterns of T1-3 beds from other area locations. Based on this analysis, the presence or absence of the T1-3 beds at the MM38 outcrop will be confirmed. If present, this information will allow much more accurate correlation between outcrops. This will, in turn, improve paleoenvironmental and paleogeographic reconstructions among area outcrops, and interpretative resolution.

The Effects of Seed Cleaner Air Velocity and Float Tests of Varying Durations on Hemp (*Cannabis sativa L.*) Seed Separation

Zachary Stevens, Undergraduate student, Agribusiness and Agriscience; Clint Palmer, Biology, Graduate student, Agribusiness and Agriscience; Song Cui, Faculty, Agribusiness and Agriscience, Faculty; Nate Phillips, Faculty, Agribusiness and Agriscience; Nate Phillips (Faculty sponsor) Agribusiness and Agriscience

Industrial hemp is extremely versatile and can be incorporated into many goods such as textiles, paper products, food, molded plastics, construction, and livestock feed. Hemp has been shown to even increase yields of other crops within its rotation, and exhibits a wide range of environmental tolerances. In 2014, it became legal for farmers in Tennessee to cultivate hemp for industrial purposes. The profitability of the crop is increasing interest among farmers. However, it is important that the most efficient means of hemp production are made available to the growers. Currently, many seeds ordered from available sources can come in unfavorable forms. Seed size, maturity, completeness, and viability can vary significantly between seed lots. Our objectives were to develop protocol that will remove the faulty seeds before germination. A seed cleaner at varying air velocity settings and float tests of varying durations were used to evaluate separation of the viable seeds from the less mature or damaged ones. Hemp seeds were divided equally, by weight (2 lbs), into 6 treatments, each replicated three times. We used three different calibrations for the seed cleaner and three float test durations and compared germination and emergence with uncleaned seeds. Half of the seeds were germinated using the paper towel method and the other half were germinated in field soil simulating the typical farmer's germination process. Among all groups, both the seeds deemed viable and non-viable were subjected to testing. Seed germination of the viable seed collection was significantly higher in the lowest velocity setting of the seed cleaner. Also, the float tests showed that the proportion of viable sunken seeds increased with increasing soaking duration. Germination and emergence of the resulting seeds demonstrate the differences between methods and provides useful information to hemp growers

Fabrication of a Novel Manufacturing Mechanism

Sloan Campbell, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

This research project is centered around a mechanism that is meant to be a less costly and more efficient option to replace an industrial robotic arm when used in proper applications. Industrial robotic arms are expensive, complex, and require highly trained individuals to program them to perform a certain task. Robotic arms typically make use of six electric motors, whereas the proposed mechanism only requires one motor that turns one direction. The concept and geometry of the mechanism were derived by Dr. Slaboch in his own research using kinematics and MATLAB, and the objective of this research project was to design and build a mechanical prototype of the mechanism. The mechanism was designed using 3D Computer Aided Design (CAD) software, and components that needed to be specially made were 3D printed and laser cut from acrylic plastic. The mechanical prototype of the mechanism was successfully constructed and required no redesigns.

Analyzing Single-Molecule Magnets with Density Functional Theory

Myranda Uselton, Undergraduate student, Chemistry; Jing Kong (Faculty sponsor) Chemistry

Single-molecule magnets have a wide range of applications in modern technology, most notably for their potential use in data storage and quantum computers. In order to use these materials, however, scientists must understand them at the fundamental level. To do this, researchers use density functional theory (DFT), a computational tool that allows researchers to calculate atomic properties in order to make predictions about a molecule's chemical structure and behavior. Dr. Jing Kong and Dr. Emil Proynov have developed a new method called KP-16 that improves DFT calculations, although it is not yet widely used. The purpose of this project is to calculate specific properties of single-molecule magnets using KP-16 and compare these results to those of other density functional methods. The main objectives of this research are to gain insight into the properties of single-molecule magnets as well as test the accuracy of KP-16 in comparison to other DFT functionals.

Assessing Freshwater Cyanobacterial Bloom Dynamics and Toxin Production in a Lentic Ecosystem

Jordan Jatko, Undergraduate student, Biology; Frank Bailey, Faculty, Biology; Frank Bailey (Faculty sponsor) Biology

Harmful Algal Blooms (HABs) are an increasing problem in freshwater ecosystems, and pose significant public health threats, including the safety of our water resources. The most common contributors to HAB formation in freshwater environments are cyanobacteria, in particular, *Microcystis*, *Anabaena*, and *Oscillatoria spp.* We are conducting a year-long study that assesses seasonal variation in algal species composition and algal toxin concentrations at J. Percy Priest Reservoir, Tennessee, which is known to experience HAB activity. In doing so, we hope to achieve a better understanding of when and under what conditions specific algal species are present, and factors influencing toxin production/availability. We have selected four sampling locations on J. Percy Priest Reservoir, all located upstream of water treatment facilities. The study will consist of four sampling events, one for each season, with each event consisting of 5 samples taken no less than 24 hours apart, all within a 30 day period. The samples will be averaged and analyzed by ANOVA/MANOVA. We will additionally sample water treatment plant effluent to determine whether algal toxins are effectively removed through water treatment. Algal species composition will be analyzed using quantitative real-time PCR. Algal toxins will be analyzed using coupled liquid chromatography and mass spectrometry. We will also take a variety of environmental measurements to better inform seasonal algal bloom dynamics and toxin production, including water temperature, phosphorous, nitrogen, flow, conductivity, dissolved oxygen, pH, and Chlorophyll A.

Examining SNF3's Role in the Virulence of *Cryptococcus neoformans*

Prianca Griggs, Undergraduate student, Biology; Erin McClelland (Faculty sponsor) Biology

This study's main focus is to understand the gene SNF3's role in the virulence of the fungal yeast *Cryptococcus neoformans*. As SNF3 is a glucose transporter and the capsule of *C. neoformans* is mostly comprised of sugars, there is reason to believe that the gene may play a role in capsule production, and in the yeast's pathogenesis. This can be tested by creating genetically modified strains of the yeast: a knockout strain and a reconstituted strain. Made by a previous student in the lab, the SNF3 knockout strain (*snf3Δ*) is complete. The reconstituted strain will be used as a control and is currently being constructed. It is comprised of three pieces: the left piece, containing the 5' untranslated region of the SNF3 gene plus the gene itself, the neomycin resistance piece, which will be used as a marker once the cells are transformed, and the right piece, containing the 3' untranslated region of SNF3. The construct as a whole will be cloned into the pAllet vector piece by piece and once it is complete, it will be inserted into the H99S strain of *C. neoformans*. We have just successfully inserted the left piece as well as the neomycin resistance marker, and are currently working on the right piece. Once the reconstituted strain is created, phenotypic testing on the knockout, the wild type, and the recombinant strain will be done, which will give key information on the function of SNF3 in *C. neoformans*. The first phenotypic test will most likely be a capsule induction, which will discern whether or not SNF3 is involved in capsule production. It is hoped that better treatments can be developed using this information which can reduce the large toll this yeast is taking on immunocompromised individuals.

Intracellular *Cryptococcus neoformans* Infection Up-regulates the M2 Polarization Marker c-Myc in Host Macrophages

Kirsten Cunningham, Undergraduate student, Biology; Linda Sircy, Graduate student, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Erin McClelland, Faculty, Biology; David E. Nelson, Faculty, Biology; David Nelson (Faculty sponsor) Biology

Cryptococcus neoformans (*Cn*) is a facultative intracellular fungal pathogen that is capable of establishing chronic infections within hosts, and kills approximating 180,000 people every year worldwide. Spores are encountered in the environment, and after inhalation, are phagocytosed by alveolar macrophages. Typically, macrophage cells will efficiently neutralize engulfed pathogens, but with *Cn*, this does not occur. Instead, *Cn* establishes a growth niche within host macrophages, and uses these cells to invade other tissues, often causing fungal meningitis and/or pneumonia. Macrophages can be polarized by endogenous and exogenous signals into either an M1 state, in which they exhibit heightened antimicrobial activity, or an M2 state, which allows them to attenuate the inflammatory response, and participate in tissue repair. Previous transcriptome profiling of *Cn* infected macrophages performed by the Nelson lab shows up-regulation of M2 marker genes, including c-Myc, a transcription factor responsible for regulation of cell growth and survival. In this study I validate this finding at the protein level, and show significantly increased expression of c-Myc in *Cn* infected cells, even while these cells are experimentally maintained in M1 polarizing conditions. I conclude that *Cn* is pushing host macrophages towards an M2 state, thereby facilitating its survival and proliferation.

Mercury in Riparian Spiders and the Potential Risk to Appalachian Mountain Birds

Andrew Todd, Undergraduate student, Biology; Gale Beaubien, Graduate student, Biology; Connor Olson, Graduate student, Biology; Ryan Otter, Faculty, Biology; Ryan Otter (Faculty sponsor) Biology

Mercury is a global contaminant capable of traveling long distances and depositing in remote areas generally thought of as pristine. Tennessee's Appalachian Mountains are a hotspot for mercury deposition (65 billion mercury units per ½ hectare) and are host to, at some point in their life cycle, over 200 bird species. Birds can be exposed to aquatic mercury when they prey on benthic macroinvertebrates (*i.e.* mayflies, caddisflies, and midges) emerging from streams. Riparian spiders, specifically those that spin webs above the land-water interface and passively prey on emerging insects, have also been shown to serve as a vector for aquatic mercury, thereby extending the aquatic food chain and serving as an additional opportunity for mercury to biomagnify. The objective of this study is to determine the potential risk of mercury to birds that consume riparian spiders. To determine the viability of spiders as an exposure pathway of mercury to birds, in August of 2016, two groups of spiders (Families: *Tetragnathidae* and *Araneidae*) were collected from four streams that span the latitudinal gradient of Tennessee's Appalachian Mountains. Whole-body homogenates were analyzed for total mercury concentrations and converted to methyl-mercury concentrations using 2017 MeHg/Hg ratios and compared to calculated methyl-mercury Spider-based Avian Wildlife Values. The mercury concentrations of whole-body spider homogenates (Tetragnathids: 101 ± 12 ng/g; Araneids: 18 ± 2.2 ng/g) exceeded calculated wildlife values for the 1-day-old Carolina Chickadee and 12-day-old Carolina Chickadee. These results show that small passerine birds residing in areas thought of as pristine can still be exposed to physiologically significant levels of mercury if they consume riparian spiders.

The Therapeutic Potential of Azaaurones for the Pathogenic Yeast *Cryptococcus neoformans*.

Miranda Lane, Undergraduate student, Biology; Erin McClelland, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

Introduction: *Cryptococcus neoformans* is an encapsulated fungal pathogen that is found in densely populated environments. It's characterized by its effect on immunocompromised individuals such as those with HIV/AIDS and cancer. There are treatments available for those infected by *C. neoformans*, with antifungal treatments that have been shown to cause extreme toxicity in the liver and kidneys. The interest of this research is with the use of azaaurones as a possible source of therapeutics in place of the existing treatments. The screening of an azaaurone library showed that these specific compounds showed significant inhibition on *C. neoformans*. **Methods:** To characterize these compounds the minimum inhibitory concentrations (MICs) were found for serotype A and D strains using the CLSI standard dilution in triplicate. Toxicity testing was done using a Mammalian Cytotoxicity Assay (MTT) with a HepG2 cell line. **Results:** Using serotype A H99S strain the MIC for AA1A and AA2A was 25 μM , AA5 was 200 μM , AA6 was 50 μM and AA6A was 6.25 μM . Using serotype D JEC21 strain the MIC for AA1A and AA6A was 12.5 μM , AA5 was 200 μM and AA6 was 100 μM . These results were observed in triplicate. The MTT assay showed cell viability above 58% in concentrations tested for AA1A and AA6. The highest concentration being 200 μM and the lowest being 12.5 μM . **Discussion:** The azaaurones showed different levels of inhibition based on the alteration of the functional group attached to the heterocyclic structure. Compound AA6A showed inhibition in the viable drug range with serotype A. It is speculated that the acylation of the nitrogen group increases inhibition of *C. neoformans*. The toxicity testing showed significant cell viability at all concentrations, suggesting these compounds are not significantly toxic to mammalian cells and may be good drug candidates for inhibition of *C. neoformans*.

How Host Gender Affects the Polysaccharide Capsule of *Cryptococcus neoformans*

Pel Doski, Undergraduate student, Biology; Erin McClelland (Faculty sponsor) Biology

Background: *Cryptococcus neoformans* (*Cn*) is a ubiquitous encapsulated yeast, typically found in soil and bird feces. This fungus causes disease in immunocompromised individuals and is responsible for 181,000 deaths every year. There is an inconsistency between the rate of infection and rate of death between male and female hosts, with males comprising 70% of the population infected with *Cn*. *Cn*'s major virulence factor is its thick polysaccharide capsule which is composed of glucuronoxylomannan (GXM) and galactoxylomannan (GalXM). Multiple studies have shown that differences in size and branching pattern of the GXM portion of the capsule affect the human immune response. We hypothesize that strains isolated from males have molecules of GXM that are larger and less branched than strains isolated from females as those molecules have been shown to not activate the immune response, which would ultimately lead to increased virulence in males versus females. **Methods:** To test this, 28 strains of *Cn* that were isolated from HIV+ patients in Botswana were grown in capsule inducing media to induce the capsule. They were then ultrafiltrated to extract shed GXM from the media or treated with DMSO to extract cell-associated capsule. Dynamic light scattering (DLS) was performed on each sample and differences in size distributions were analyzed. TEM was also performed and branching differences were analyzed. **Results:** DLS data on the sizes of the shed capsule showed no significant difference between strains isolated from males and females. DLS data on the size of the cell-associated capsule is currently being analyzed while TEM data collection is still underway. **Conclusions:** Current data suggests that while the size of shed GXM may not contribute to the increased disease seen in men, differences in branching patterns and cell-associated capsule may provide more understanding to the disproportionate infection and death rates between male and female hosts.

Foreign Language in Selected Literature

Natalie Jones, Undergraduate student, English; Patricia Gaitely (Faculty sponsor) English

According to a 2016 study by the United States Census Bureau, more than five hundred languages are spoken in the United States. American English is the primary language for most citizens, but the number of bilingual or multilingual Americans is on the rise. With an increase of multilingualism, American literature examining the relationships between language and culture becomes much more vital to understanding modern American society. Even novels written in English can provide invaluable insight to a minority culture, especially when an author chooses to flavor the text with foreign language.

A second language has a particular impact on the characters within novels as well as on outside analysis. Of many books written by multilingual authors, this project focuses on three diverse novels which incorporate a language other than English into the text: Rudolfo Anaya's *Bless Me, Ultima*, Amy Tan's *The Joy Luck Club*, and Tim Gautreaux's *Same Place, Same Things*. Among other aspects, the three novels share bilingual characters, an interest in characters' intergenerational relationships, and the occasional but significant use of a second language. All three novels are written primarily in English, but incorporate secondary languages to enrich both an external reading experience and the internal characters' interactions. Little prior research exists in examining instances of foreign language as a literary device, and this project seeks to expand the field of literary analysis regarding a secondary foreign language.

The use of a second language in each novel changes the reader's view of the characters' internal motivations and actions, and in turn influences how the audience interprets the book as a whole. This interpretation has the power to change one's worldview. As the United States continues to expand linguistically and culturally, understanding "different" might make all the difference between peaceful multiculturalism and tense separatism.

Comment: Abstract Formatting: This abstract includes book titles, which should be italicized. Such instances are marked with asterisks (e.g., ""Rudolfo Anaya's *Bless Me, Ultima*"").

Novel Tripodal Ligands with Phosphorus/Nitrogen Mixed Donors and Their Base Metal Complexes

David Tyer, Undergraduate student, Chemistry; Keshav Paudel, Graduate student, Chemistry; Keying Ding (Faculty sponsor) Chemistry

The development of new types of ligands which can offer extraordinary stability to earth abundant base metal active centers remains as an interesting topic in organometallics. It is highly desirable if the ligands could directly participate in bond activations as it may offer unique reactivities compared to traditional catalysts without ligand cooperativities. We report the synthesis of a class of tripodal ligands featured with mixed P, N donors. We are interested in tetradentate tripodal ligands for two reasons. First of all, it may provide extra stability to the reactive intermediates by enforcing five or six coordination on the metal center. Secondly, due to different coordination environment, the metal complexes coordinated by these ligands may have very different catalytic reactivities from those of tridentate pincer ligands which currently dominate dehydrogenation and dehydrogenative coupling reactions. Herein we present the synthesis and characterization of cobalt and iron complexes with these ligands. X-ray crystal structures revealed distorted trigonal pyramidal geometry around metal centers. These metal complexes presented excellent air stability and could serve as potential catalysts for dehydrogenation and dehydrogenative coupling reactions.

Toward Microscopic Equations of State for Core-Collapse Supernovae from Chiral Effective Field Theory

Bassam Aboona, Undergraduate student, Physics and Astronomy; Jeremy Holt (Faculty sponsor)
Physics and Astronomy

Chiral effective field theory provides a modern framework for understanding the structure and dynamics of nuclear many-body systems. Recent works have had much success in applying the theory to describe the ground- and excited-state properties of light and medium-mass atomic nuclei when combined with *ab initio* numerical techniques. Our aim is to extend the application of chiral effective field theory to describe the nuclear equation of state required for supercomputer simulations of core-collapse supernovae. Given the large range of densities, temperatures, and proton fractions probed during stellar core collapse, microscopic calculations of the equation of state require large computational resources on the order of one million CPU hours. We investigate the use of graphics processing units (GPUs) to significantly reduce the computational cost of these calculations, which will enable a more accurate and precise description of this important input to numerical astrophysical simulations.

The Variety of Censorship

Ella Colbert, Undergraduate student, Sociology and Anthropology; Sean Dixon, Undergraduate student, Music; Sandra Cavender (Faculty sponsor) English

This poster displays why censorship occurs within the news and within music. Media outlets feel the need to censor graphic or sensitive material in order either sell more content as well as inform a broader audience. The issue with censorship is that many feel that it infringes upon their 1st amendment right to their freedom of speech and press. In the case of music, since it is a form of art, it should not be censored. However, when it comes to the news, there are certain circumstances when censorship is beneficial.

Identity Theft

Leah Patton, Undergraduate student, Psychology; Sandhya Singh, Undergraduate student, Accounting; Tanner Brown, Undergraduate student, English; Sandra Cavender (Faculty sponsor) English

Our project will discuss a serious media issue. One of the main media issues is identity theft. Sana, Tanner, and I were researching on the issue, and decided to construct a poster together. Our poster will describe how identity theft affects the victim, how the victim can get help, and how it can prevent from happening again. Our poster will also provide statistics, showing the rate of identity theft and how it has increased over years. There will be statistics on the number of global data breaches pertaining to identity theft. Lastly, statistics on the age group that's mostly affected by identity theft. Also, we will describe how different medias have been affected by identity theft. Also, there will be information provided by the media, and information that's not provided by the media pertaining identity theft. Our project will explain how identity theft cannot be erased, but it can be prevented.

Effectiveness of zinc-based footbath solution over industry standard copper-based solutions for the prevention and treatment of digital dermatitis in dairy cattle.

Christina Davis, Undergraduate student, Agribusiness and Agriscience; Jessica Carter, Faculty, Agribusiness and Agriscience; Song Cui, Faculty, Agribusiness and Agriscience; Jessica Carter (Faculty sponsor) Agribusiness and Agriscience

Effectiveness of zinc-based footbath solution over industry standard copper-based solutions for the prevention and treatment of digital dermatitis in dairy cattle.

Christina Davis, Song Cui, Jessica Carter

Middle Tennessee State University, School of Agribusiness & Agriscience, Murfreesboro, TN

Digital Dermatitis (DD) and other hoof related problems have a major financial impact on dairy farms as well as a negative effect on cow welfare. Copper Sulfate has been a long-standing gold standard in the prevention of the bacteria that cause these hoof infections. In this project, we compared Copper Sulfate solution with Hoof-Zink E-Z Liquid (Sirius LLC, Waterloo, NE), a Zinc Chloride solution. The milking herd at the Middle Tennessee State University Experiential Learning Dairy Unit was used in this study. Data were collected on all Holstein cows in the milking herd (n=34). The cows were directed through a walk-through split footbath (Copper solution on left side and Zinc solution on right side) after the afternoon milking on three consecutive days (Wednesday, Thursday, & Friday) each week for a period of thirteen weeks. Cows were scored every Friday in the milk parlor during their regularly scheduled milking. Cows were evaluated on leg cleanliness (score 0-3 based on amount and type of manure present) and presence of digital dermatitis (M-stage classification system; M0 - M4 based on presence of foot lesions and severity). Individual cow production data were collected which included daily milk yield, conductivity, activity, and rest bouts. Production data are being analyzed using the mixed model procedure with repeated measures in SAS and the FREQ procedure will be used to determine prevalence of DD.

Aerodynamic and Acoustic Analysis of a Barn Owl Biomimetic Airfoil

Salman Rahmani, Undergraduate student, Aerospace; Nate Callender (Faculty sponsor)
Aerospace

For years, the human race has turned to nature for inspiration on how to better understand the world in which we live. In particular, aerospace engineers frequently examine birds to gain a fundamental idea on how to improve the characteristics of flight. With the development of the Unmanned Aerial Vehicle (UAV), helicopter, and large passenger aircraft, a rising problem in the aerospace community is the amount of noise that these crafts' propellers produce. This problem is of substantial stature in the sense that it is a disturbance to residential neighborhoods, hampers stealth operations for specialized combat units, and proves the fact that there is still a lot to learn about the physics of flight.

In this project, the undergraduate researcher will attempt to analyze sound properties of an aircraft propeller that has been retrofitted with modifications inspired by barn-owls, also known as *Tyto Alba* (Peregrine, n.d). These modifications include leading edge 'combs' and trailing edge 'fringes'. In addition to providing data and results on sound, the researcher will also provide an aerodynamic analysis in hopes of providing a more immersive understanding of the results.

Contributions of Early MTSNS Faculty in Establishing the Tennessee Academy of Science

Hunter D. Hudson, Undergraduate student, Chemistry; Martin V. Stewart, Faculty, Chemistry;
Martin V. Stewart (Faculty sponsor) Chemistry

The Tennessee Academy of Science (TAS) was founded in 1912, which was only one year after the first fall quarter of Middle Tennessee State Normal School (MTSNS) that began September 11, 1911. This presentation summarizes the contributions of early faculty members in helping to establish the Academy. Biographies for each were constructed through archival research from the Special Collections Room of the Walker Library and Albert Gore Research Center of MTSU, the Tennessee State Library and Archives in Nashville, and the Historical Research Room of the Linebaugh Library in Murfreesboro. Chronologically, the faculty featured herein are Archibald Belcher, Jeanette King, Verd Peterson, and William Mebane. The scope of this work will extend through 1943 when Mebane left the campus to join the war effort as a naval officer. History demonstrates that the tendency of the science faculty of MTSU to engage in outreach activities began during the earliest days of the institution and helped to prevent its isolation. Our project intends to clarify the vaguely documented beginnings of MTSU, giving due credit to our founding science faculty, without whom our College of Basic and Applied Sciences might not have the prestigious faculty, reputation, or resources that it currently enjoys. Support from the Undergraduate Research Council of the College of Basic and Applied Sciences at MTSU is gratefully acknowledged.

Acoustic Bandgap Structures Based on One-Dimensional Maximal-Length-Sequence Waveguide Filters

Stephanie Lough, Undergraduate student, Physics and Astronomy; William Robertson (Faculty sponsor) Physics and Astronomy

There are many applications where the reduction of acoustic noise can be beneficial, for example reducing the noise that might be emitted from an air conditioning unit in an office building. Periodic waveguide filters-referred to as acoustic bandgap filters or sonic crystals-created from alternating segments of high and low acoustic impedances are well documented. In these periodically modulated waveguides the effects of reflection, transmission, and interference results in forbidden transmission bands-acoustic band gaps, or the aforementioned acoustic noise. Our aim is to broaden these band gaps even further with the use of maximal-length-sequence waveguide filters. We show that a waveguide filter with a maximal-length-sequence profile is greatly superior to a periodic acoustic filter of equal length and number of alternating impedance segments. The maximal-length-sequence waveguide filters yield a greater reduction in transmitted frequencies than their periodic counterparts. The significance of this experiment is to test the acoustic effectiveness so that we may someday apply the same idea to optics. We hope that this will lead to promising technologies in the future, both in acoustics and optics.

Mercury Concentrations in Terrestrial and Aquatic Primary Consumers in Tennessee's Appalachian Mountains

Jaylen Sims, Undergraduate student, Chemistry; Gale Beaubien, Graduate student, Biology; Connor Olson, Graduate student, Biology; Andrew Todd, Undergraduate student, Biology; Ryan Otter, Faculty, Biology; Ryan Otter (Faculty sponsor) Biology

The Appalachian Mountains are typically thought of as pristine, but due to their high elevation and location, they are susceptible to atmospheric deposition of non-point source contaminants such as mercury. Mercury is traditionally thought of as an aquatic problem because once it reaches the aquatic environment, sulfate-reducing bacteria may convert mercury into its bioavailable form, methylmercury. Previous research has shown that methylmercury can bioaccumulate in primary consumers and biomagnify through aquatic and terrestrial food webs. The objective of this study was to determine if terrestrial and aquatic primary consumers have comparable mercury concentrations. To determine this, an aquatic primary consumer (caddisflies, Order: *Trichoptera*) was collected at four sites spanning the latitudinal gradient of Tennessee's Appalachian Mountains. Additionally, a terrestrial primary consumer was sampled concurrently; millipedes (Class: *Diplopoda*) were collected at three sites and terrestrial snails, (Class: *Gastropoda*) were collected at one site. Whole-body homogenates were analyzed for total mercury concentrations, and subsamples were analyzed for methyl-mercury. Results show that total mercury concentrations in millipedes ($470 \pm 110 \mu\text{g}/\text{kg}$) and snails ($16.2 \pm 5.66 \mu\text{g}/\text{kg}$) exceeded total mercury in aquatic primary consumers ($3.3 \pm 1.18 \mu\text{g}/\text{kg}$). Currently, no explanation can be given on why millipede mercury concentrations were over an order of magnitude greater than the aquatic primary consumer used in this study.

Efficacy of HPL1A Cell Culture as a Host for Influenza A Viruses

Ashley Gambrell, Undergraduate student, Biology; Stephen Wright (Faculty sponsor) Biology

The growth of influenza A viruses for vaccine preparation has historically been restricted to using embryonated chicken eggs, but mutations and low virus yield have prompted research into new hosts. Human peripheral lung cell line HPL1A is a normal, human cell line that was hypothesized as a possible host option to grow influenza. Six different influenza A viruses, including subtypes H1N1, H2N2, and H3N2 were chosen for this investigation. After the initial virus stock was grown from eggs, the allantoic fluid was harvested. Hemagglutination assays (HA) were performed on each sample to ensure there was virus to work with. Each virus was then diluted to a final HA titer of 32 before being used to infect the cells. The HPL1A cells were exposed to virus and given two or more days to incubate. Media was drawn off on the second through fifth day and stored at 4° C. The collected media was then tested with an HA and five of the six viruses were determined to have titers indicating viral growth. Optimum virus growth occurred after two and three days in cell culture. This research suggests that with time and further study, these viruses may become cell adapted, possibly giving high enough titers to produce vaccines or allow for more in depth study of the viruses' behavior in human cells.

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Domestic abuse in the Media

Ashleigh Yancy, Undergraduate student, Art and Design; Janice Penny, Undergraduate student, Sociology and Anthropology; Sandra Cavender (Faculty sponsor) English

My partner and I have tried to capture domestic abuse and how technology can aid it. I focused on the technology that has recently been developed and how it helps the attacker hurt the victim. I talked about the ways technology can hurt the victim. The attacker can use different platforms like GPS, spyware, social media, and email as ways to pursue the victim. I made a valid point in how domestic violence can extend beyond the physical. My partner focused on the physical and most known aspect of domestic violence. She shed a light on the media and news coverage these types of stories get. She also gave some statistics and valid data points on the victims of domestic abuse. She compared Domestic abuse in different countries and questioned are ways of helping the victims. We definitely wanted to raise awareness for these people suffering from abuse. There are more people out there experiencing this than we think.

Numerical Study of Phase Transitions in Quantum Materials

Kristin Barton, Undergraduate student, Physics and Astronomy; Hanna Terletska (Faculty sponsor) Physics and Astronomy

Quantum materials feature an array of exotic properties, which, if understood and utilized, present promising potential for future computer technologies as well as energy transmission and storage. One of the most important classes of quantum materials is strongly correlated electron systems. These are systems in which exotic properties (such as Mott insulators, high-temperature superconductivity, and quantum magnetism) emerge due to the strong interactions between electrons. However, these systems are difficult to study theoretically since the standard mean field theories and perturbative techniques do not apply in the strongly correlated regime. For this reason, numerical techniques, which include many-body correlation effects, are needed for the proper analysis of such systems. In this study, we apply dynamical mean field theory to the Hubbard model to investigate the effect of temperature and electron-electron interactions on the metallic state of the system. We demonstrate that both temperature and strong electron-electron interactions can dramatically change the properties of the system and induce the Mott metal-insulator transition. Based on our results, we construct the phase diagram along with the effects of temperature and electron interaction strength on the transition. Additionally, we find that the Mott metal-insulator transition is a first-order phase transition with a coexistence region below the critical temperature. The current study is done by approximating interaction between the electrons to the local component only, so in the future we plan to extend towards more realistic systems by including the non-local inter-site interactions as well.

Molecular Identification of Anti-Viral Metabolite Produced by *Mangifera persiciformis*

Clinton Holladay, Undergraduate student, Biology; Stephen Wright (Faculty sponsor) Biology

Herpes Simplex Virus Type 1 (HSV) infects 50%-90% of the population. These lifelong infections are asymptomatic or cause recurring lesions at the original site of infection. These lesions can become opportunistic infections in immunocompromised individuals. Another serious complication arising from HSV infection is meningitis in neonatal patients born to infected mothers. Currently there are no cures or vaccines for this disease. The only method to prevent infection is to avoid physical contact with infected individuals. The limited options available to treat HSV infections combined with an increase in viral resistance are the driving factors in the research being conducted to identify new options for treatment of these infections. The Tennessee Center for Botanical Medicine Research uses Traditional Chinese Medicine plants as its source of plant material for searching out novel compounds to treat disease. *Mangifera persiciformis* has been identified as having anti-HSV-1 activity. We report that a crude extract is able to prevent herpes replication by 90%. Activity confirmation, chromatographic extract fractioning, compound isolation and concentration, and compound identification via Nuclear Magnetic Resonance imaging techniques is the focus of this research. Currently, research is being conducted at the steps of single compound purification and concentration so that a structural determination can be obtained. Structural determination will determine if the active compound is novel and if not, allow for any previously determined activity associated with the active molecule to be combined with the current findings.

Callus Initiation in *Cannabis Sativa* via Plant Tissue Culture Methods

Xoe Thacker, Undergraduate student, Biology; Kayla Thomas, Undergraduate student, Biology; Shannon Smith, Graduate student, Biology; John DuBois, Faculty, Biology; John DuBois (Faculty sponsor) Biology

Historically, industrial hemp (*Cannabis sativa L.*) has been a valuable source of metabolites and compounds, such as cannabidiols. There is a need for large amounts of plant tissue to be grown under controlled environments, and plant tissue culture is one unique way to yield and preserve this tissue. The purpose of this study was to determine the optimal concentration of growth hormones, as well as, the optimal salt mixture in media for callus induction and growth in a select number of hemp cultivars. The cultivars of interest were Canda, Joey, CFX-2, and Futura. To find the optimal hormone concentration/ratios, 16 different combinations of auxin:cytokinin (μM) were evaluated. The three salt mixtures evaluated were Murashige and Skoog (MS), MB5D1K, and an experimentally-determined medium (MTSU). The top performing hormone formulations were determined to be equal concentrations (i.e. 1:1, 2:2, 3:3). The top performing salt mixture was determined to be MS medium followed by MB5D1K. These findings have implications for the optimal growth of callus tissue, while a formula to initiate trichome production is being studied. Specific cannabidiols of interest are known to be present in the trichomes and we hope to isolate these compounds from trichomes and further analyze them for medical implications.

The Dibenzalacetone Roller Coaster: An X-ray and Computational Study of Conformational Isomers

Andrew Tanyous, Undergraduate student, Chemistry; Jakub Wojciechowski, Visiting scholar, Technical University of Lodz, Poland, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

Dibenzalacetone (DBA), or 1,5-diphenyl-1,4-pentadien-3-one, is a product synthesized via a base-catalyzed aldol condensation of acetone and benzaldehyde in the Organic Chemistry II laboratory. The molecular structure of DBA suggests that the compound can have three conformational minima defined by the carbonyl and alkenyl: *s-trans, s-trans* (TT), and *s-trans, s-cis* (TC), and *s-cis, s-cis* (CC). The energetic benefits that come from pi orbital overlap due to conjugation normally favor the TT form. However, in DBA these electronic effects are counterbalanced by steric congestion in the planar form. Crystals of the pale yellow compound were obtained at three different temperatures: room temperature (25 °C, -20 °C and 80 °C). X-ray analysis showed that temperature of the crystallization affected the ratio of the different conformations found in the crystal. Crystals formed by cooling solutions to room temperature contained TT and TC in nearly equal amounts. The molecules occupied the same position in crystal overlaying each other with ~50% occupancy. In crystals prepared at low temperature, only TC was observed. However, these had two overlaying positions in ratio 1:5. To give more insight into this phenomena, a conformational analysis was done in the Gaussian package using B3LYP(*d,p*) with the simulation of solvent and a dispersion correction applied to improve the model of the solid state structure. In this presentation, we will discuss the calculated rotational barriers and their relationship to the solid state structures.

Suitability of Chicken, Broccoli, and Rice Casserole as a Menu Item for Public School Nutrition Programs

Amanda Mason, Undergraduate student, Human Sciences; Joshua McCrary, Undergraduate student, Human Sciences; Lisa Sheehan-Smith (Faculty sponsor) Human Sciences

Food products served by public school systems must meet federal nutrition guidelines, be compatible with the school's budget, and acceptable by a majority of students. In addition, the production of the food item must be feasible, given the skill level and time constraints of the staff. An informal study was conducted by two dietetic students to determine whether a chicken, broccoli, and rice casserole met these criteria for inclusion in a public school's lunch menu. The results of the cost, production requirements, nutritional value, and acceptability of this recipe provided school food service managers with insight for the development of future lunch menu items.

The chicken, broccoli, and rice casserole was prepared using the school's food service equipment and ingredients commonly stocked by the school, including two commodity food items. Recipe cost was calculated based on the vendor pricing for each ingredient, and the nutrient content was analyzed using the nutrient analysis software, FoodWorks. Sensory data was collected from 37 fifth-grade students selected to sample and evaluate the product. Results of the study indicated the product was acceptable by a majority of the students, economical, easy to prepare, and would be chosen by most students if offered in the cafeteria. The product did not meet the federal nutrition guidelines for calorie, sodium, and fat content. To be added to the school's menu, the recipe would need to be modified or the weekly menu carefully planned to compensate for the nutrient discrepancies.

Differentiation of Ignitable Liquids by Using Direct Analysis in Real Time Mass Spectrometer (DART-MS)

Isabella Barnett, Undergraduate student, Chemistry; Mengliang Zhang (Faculty sponsor)
Chemistry

Ignitable liquids (IL) such as gasoline and kerosene are commonly used as accelerants in arson crimes, therefore, IL identification is an important topic in arson investigation. American Society for Testing and Materials (ASTM) E1618 gas chromatography/mass spectrometry (GC/MS) method is often applied to designating samples into one of seven classes defined by ASTM. Ambient mass spectrometry methods such as direct analysis in real time mass spectrometry (DART-MS) can be alternative methods for IL identification which enable the direct sample analysis without chromatographic separation. Therefore, 10 IL samples were selected from different classes and were investigated by using DART-MS in our study. They were tested under different conditions, including pure samples, weathered samples of varying degrees, samples diluted in solvents, and samples on a substrate, carpet. A volume of 5 μL or 10 μL sample was spotted onto QuickStrip Sample Card in triplicates. For all of the DART-MS experiments, the pre-loaded "QuickStrip" or "QuickStrip temperature profile" method was used, the ionization gas was helium, and the mass spectra were collected in an m/z range of 50–1000 in positive-ion mode. Mass spectra for different ILs were compared and characteristic ions or ion clusters were observed. Comparing with conventional GC/MS method which requires about 30 min for the analysis of each IL sample, the run time for IL analysis by DART-MS was less than 1 min per sample. In the current study, the DART-MS has shown potential for the rapid screening of IL samples.

Star Blaster: An Effort In Collaborative Game Development

Cory Nelson, Undergraduate student, Computer Science; Adam McInturff (Faculty sponsor)
English

There is a substantial lack of opportunities for STEM and Humanities students to find common creative ground at MTSU. In an effort to fix this problem, students with experience in software development, art, animation, electronics, music, and woodworking have come together to develop an arcade booth and a multiplayer cooperative video game. For programmers, this project has involved incorporating version control to improve development speeds and aid in the debugging process, as well as provide an opportunity for all developers to become immersed in Agile Software Development methods. Artists have had the opportunity to experiment with sprite animation, game art, woodworking, and painting; musicians worked to create loopable arcade-style electronic music. The purpose of this project is to provide a student-developed means of collaborative and recreational engagement for students at MTSU, as well as encourage students to pursue extracurricular STEAM activities with student organizations at MTSU. This project was developed by Sandbox, a student organization which aims to give creators an outlet and provide practical, collaborative experience. This project represents the ideals of the organization, and is a demonstration of the style of project we will create in the future.

The Emerging Danish Nationalist Identity in Niels Gade's Opera *Elverskud*

Giuliana Chavez Rojas, Undergraduate student, Music; Joseph Morgan (Faculty sponsor) Music

This article investigates the synthesis of the cosmopolitan European ideologies and the nationalist musical traditions of Denmark in the unstaged opera, *Elverskud* (Elf-king), by composer Niels Gade. The purpose of this research is to enrich the resources regarding nationalist music of Denmark and describe how this culture and nationalist movement was manifest in its music. For this project, I translated the Nordic myth “The Elverskud” and the libretto drawn from it. I also completed a harmonic and melodic analysis of the opera and translated many of the primary and secondary sources from Danish and German into English. Additionally, I investigated the history of the text and of the composer as well as the librettists, and the reception of the work to discover why it holds national importance in Danish arts. This research was intended for students of and people interested in the history of Denmark, its music, mythology (Nordic), and literature.

Elements and Principles of Design Interactive Museum

Alejandra Pantin Hernandez, Undergraduate student, Art and Design; Janis Brickey (Faculty sponsor) Human Sciences

The project was to design and construct a model of an interactive museum that showed the elements and principles of design. These are: point, line, form, shape, plane, volume, balance, rhythm, harmony, scale, unity, contrast, emphasis, proportion, texture, and pattern. The project was not focused on a specific audience, but the design of the museum allowed for a group of 15 people maximum since it was a guided interactive experience. Before building the individual model, classmates had to join in groups of 4 to develop a structure design of the building by combining individual design ideas done in SketchUp. After having a structure design, each member of the team had to develop their own design by adding, subtracting, and changing the group structure design. The individual design project was divided in 3 main phases: programming and schematics, model construction, and drafting. The first phase, programming and schematics, was the thinking-ideation phase. This is where the design is developed by revising all functionality, space, and aesthetics of the design. The second phase, model construction, is based on putting the 2-D design in a 3-D model. The model was made using a variety of materials, such as foam board, bristol board, matte board, card-stock color papers, glue, and tape. The third phase, drafting, consisted in drawing floor plans of every level (3-level museum), section cuts both transverse and longitudinal, elevations, and isometric drawing of the first 5 feet of the structure. All these steps and phases allowed me to develop a 3-level museum that showed the elements and principles of design. By having the project broken into phases, it made it easier to accomplish each required task.

Phosphorous Aggregate: A Sustainable Light Source with the Adoption of Glow in the Dark Aggregate

Benjamin Patrick, Undergraduate student, Concrete Industry Management; Heather Brown (Faculty sponsor) Concrete Industry Management

The research objective is to determine various concrete applications of products from Element Glo, a material distributor specifically in the phosphorous aggregate division. The study is to determine if phosphorous aggregate can ultimately improve lighting in areas around campus and parks for an affordable price. Testing has begun using two different types of Cements: a standard Type 2 Portland Cement and White Cement. Other tests include: light circumference from light poles vs. lighting from phosphorous aggregate on the ground, the time it takes to charge vs. the time it stays in effect overnight. The data will be formulated based on: the amount of aggregate needed, the pricing based on square footage, the area of coverage, the long term maintenance that may be needed, the cost difference between that and normal light poles in areas of coverage, and lasting ability over the course of a night. Ultimately, based on the date the catalyst behind this research will be if phosphorus aggregate is a cheaper and more sustainable light source for the future of our campus and parks.

Genome-Wide Identification of Antisense lncRNAs and their Expression and Genetic Polymorphism Associated with Susceptibility to *Flavobacterium psychrophilum* in Rainbow Trout

Ali Ali, Graduate student, Biology; Rafet Al-Tobasei, Postdoctoral fellow, Computational Science; Mohamed Salem, Faculty, Biology; Mohamed Salem (Faculty sponsor) Biology

Eukaryotic genomes encode several antisense long-noncoding RNAs (lncRNAs) that regulate gene expression. Recently, we identified few lncRNAs correlating with immune-related genes, however, a systematic genome-wide analysis of lncRNAs in rainbow trout is lacking. To identify antisense transcripts, 134 RNA-Seq libraries from 5 different datasets were used. A total of 14,025 lncRNAs were identified genome-widely. 75.5% of lncRNAs showed multiple exons compared to 36.5% of the intergenic lncRNAs. About 7% of lncRNAs exhibited tissue-specific expression. RNA-Seq libraries from three genetic lines of rainbow trout with significant differences in survival rate following *F. psychrophilum* (*Fp*) infection were analyzed to investigate role of the lncRNAs during infection. 24 pairwise comparison between the different genetic lines, infectious status, and time points revealed 421 lncRNAs with differential expression (DE). In addition, 234 sense genes showed differential and strongly correlated expression with their lncRNAs. The list of the DE sense/AS pairs includes immune-related genes. Of them, six inverse correlations were identified between DE lncRNAs and coding counterparts such as genes encoding for CTP synthase and nuclear factor 1 C-type. Promoter analysis of sense/AS pairs revealed high representation of transcription factors binding sites that are critical to immune cell development/response including c-Jun, STATs, IRFs, PAX-5, and GATA3. Additionally, a 50K cSNP-chip identified 338 SNPs within sense/lncRNAs overlapping regions. Those SNPs showed allelic imbalances between genetic lines and infectious status. Collectively, lncRNAs represent an important layer of the molecular architecture of fish immunity, and could be used to develop biomarkers for genomic selection and genetic manipulation of aquaculture species.

Small RNAs Involvement in *Flavobacterium psychrophilum*-Rainbow Trout Host Pathogen Interactions

Pratima Chapagain, Graduate student, Molecular Biosciences; Ali Ali, Graduate student, Molecular Biosciences; Yniv Palti, Government agency collaborator, USDA; Gregory Weins, Government agency collaborator, NCCWA; Mohamed Salem (Faculty sponsor) Molecular Biosciences

Gram-negative bacteria's outer membrane vesicles (OMV's) contain sRNAs and virulence factors that can be released from the bacterial surface during host-pathogen interaction. We hypothesized that sRNAs interact with host genes and impact their expression. To begin to test this hypothesis we first mapped all publicly available RNA-Seq reads from *F. psychrophilum* (Fp) onto the *Fp* genome (strain CSF-259). A total of 267 sRNAs were identified in the *Fp* genome. We then used computational analyses to identify 535 trout's immune-related genes possibly targeted by these sRNAs (free energy cut off value ≤ -25.0 kcal/mol).

Potential interaction of 10 sRNAs-trout immune genes were investigated in two rainbow trout genetic lines, ARS-Fp-R (resistant) and ARS-Fp-S (susceptible), created by selective breeding and showing significant variation in the survival rate after 21 days of exposure to the *Fp*. qPCR was used to determine the reciprocal expression of the sRNA and their targets in whole-body lysates after 5 days of infection. B-actin and Prolyl-tRNA synthetase were used as reference genes for trout mRNA and *Fp*-sRNA measurements, respectively.

Interestingly, three immune-related genes; macrophage migration inhibitory factor (MIF), autophagy related protein-9A and mitogen activated protein kinase-7 (MAPK) were downregulated in the susceptible compared to resistant fish, whereas, three sRNAs targeting those genes were reciprocally upregulated (p-value

Development of a 50K Transcribed Gene SNP chip Identifies Major QTL Affecting Growth And Muscle Yield In Rainbow Trout Through GWAS Analysis

Ali Ali, Graduate student, Biology; Rafet Al Tobasei, Postdoctoral fellow, Computational Science; Mohamed Salem, Faculty, Biology; Mohamed Salem (Faculty sponsor) Biology

Coding/functional SNPs change the biological function of a gene, therefore, may lead to identification of causative alleles within QTL and development of genetic markers with large-effects on phenotypes. Two bioinformatics pipelines, GATK and SAMtools, were used to identify ~21K transcribed SNPs with allelic-imbances associated with important aquaculture production traits including WBW, muscle yield, muscle fat content, shear force, and whiteness in addition to resistance/susceptibility to bacterial cold-water disease (BCWD). SNPs were identified from pooled RNA-Seq data collected from ~620 fish, representing 98 families from a growth- and 54 families from a BCWD-selected lines with divergent phenotypes. In addition, ~29K transcribed SNPs without allelic-imbances were strategically added to build a 50K Affymetrix SNP chip. Selected SNPs included 2 SNPs per gene from ~14K genes and ~5K non-synonymous SNPs. The SNP chip was used to genotype 1,728 fish. The average SNP calling-rate for samples passing QC (1,641 fish) was $\geq 98.5\%$. GWAS analysis on 878 fish (representing 200 families from 2 generations) X 31K polymorphic markers (passing QC) identified major QTL explaining up to 22% and 15% of the genetic variance of body-weight-gain and muscle yield, respectively. Most of the genes in the QTL regions were previously reported as important regulators of mammalian growth and muscle yield including the activin receptor type-1B and citrate synthase genes. These results indicate utility of the transcribed gene SNP chips in GWAS studies allowing identification of major QTL affecting important traits in rainbow trout.

Holographic Reduced Representations for Dimensional Attention learning

Huizhi Wang, Graduate student, Computer Science; Joshua Phillips (Faculty sponsor) Computer Science

Machine learning contains various subfields, one of which used to categorize items is called category learning (dimensional learning). The research entails how we learn to categorize items. Researchers developed a model called ALCOVE and implemented this method on the computer to simulate this behavior. Furthermore, additional research made this model more realistic and closer to human brain activity by incorporating TD learning (Temporal Difference Learning) into this model. However, this model is currently incomplete with common distributed encoding techniques like Holographic Reduced Representations.

Therefore, we intend to do is to replace the mapping function with the convolution method employed by the Holographic Reduced Representations (HRR). The original function is only limited to three dimensions and difficult to be used in learning experiments. Convolution could compress more features into the learning procedure, which is also closer to human learning behavior. We expect it to have similar performance to the original ALCOVE. If this method is proved to be valid for dimensional attention learning, we could plug this method into other cognitive architectures which can't use the basic ACLOVE method due to the aforementioned limitation.

Energy Aware, Time and Throughput Optimization for Workflow Scheduling in Cloud Environments using Genetic Algorithm

Chandu Naga Vardhan Budati, Graduate student, Computer Science; Yi Gu (Faculty sponsor)
Computer Science

With the ever-increasing deployment of data centers and computer networks around the globe, Cloud computing has emerged as one of the most important paradigms for large-scale data-intensive applications. Typically, a cloud environment is a collection of data centers consisting of thousands of servers equipped with different networking technologies. These servers and centers require massive cooling systems to maintain the required operating temperatures.

It is estimated that servers and cooling systems combined use up to 80% of all the electricity within a data center. But, these cloud environments face many challenges related to energy consumption, execution time, Heat and Carbon dioxide emission, and operational cost. Due to the extreme large scale of the applications and resource consumption, even a small improvement in any of the above-mentioned challenges can yield huge ecological and financial rewards. Therefore, optimizing energy consumption and reducing carbon footprint of data centers have been considered as increasingly important challenges. Efficient workflow scheduling in cloud environments is one of the most substantial ways to confront the challenges and achieve optimal resource utilization.

In this work, we propose an Energy Aware, Time and Throughput Optimization heuristic (EATTO) based on the BAT algorithm, to solve our multi-objective optimization problem of workflow scheduling. We consider our initial optimization problem a search problem in an n -dimensional search space, where each subtask in the application is representing a dimension. We formulate a multi-objective function which is used to measure the distances in this plane. We then demonstrate the performance superiority of our EATTO algorithm over other existing mapping solutions using an extensive set of performance evaluations and comparisons.

Predicting Stigmatizing Attitudes Against Mental Illness Based on Mental Health Literacy

Angela Bowman, Graduate student, Health and Human Performance; Tara Prairie, Graduate student, Health and Human Performance; Norman Weatherby, Faculty, Health and Human Performance; Andrew Owusu, Faculty, Health and Human Performance; Jwa Kim, Faculty, Literacy Studies; Norman Weatherby (Faculty sponsor) Health and Human Performance

INTRODUCTION: Mental illness is the leading cause of global disease burden for those age 18 to 29. In the United States, it is estimated that 43 million Americans are impacted by mental illness each year, with an estimated annual cost of \$467 billion. People labeled as mentally ill are more harshly stigmatized than those with any other health condition regardless of level of disability. The general lack of knowledge surrounding mental illness has been hypothesized to result in a high burden of stigma associated with being labeled as mentally ill, such as failure to seek treatment which translates to significant social, economic, and personal cost. The purpose of the current project is to examine the relationship between mental health literacy and stigmatizing attitudes towards mental illness.

METHODS: Data, including demographics, were collected (N = 398; Age = 18-29) from a southeastern university using the newly created Revised-Mental Health Literacy Scale (R-MHLS) and The Knowledge Test of Mental Illness (KTMI), a scale designed to diminish social desirability bias by covertly measuring stigma.

RESULTS: When controlling for gender and prior experience with mental illness, mental health literacy was a significant predictor of scores on a covert (KTMI) measure of stigma $F(3, 394) = 20.10, p < .001$, with $R^2 = .13$.

CONCLUSION: Implementation of the new mental health literacy scale in public health programs, along with interventions that improve mental health literacy, will help health educators lessen the burden of stigma against people with mental health problems.

The Roles of Perceived Candidate Honesty and Effectiveness in Voter Choices during the 2016 U.S. Presidential Election

Kimberli Conro, Graduate student, Media and Communication; Ken Blake, Faculty, Journalism, Office of Communication Research; Jason Reineke, Faculty, Journalism, Media Studies; Ken Blake (Faculty sponsor) Journalism, Office of Communication Research

Public opinion about the honesty of presidential candidates has rarely played a decisive role in U.S. election outcomes over the past 60 years (Wattenberg, 2016), perhaps partly because American journalism's objectivity norm (Schudson, 2001) has discouraged journalists from unilaterally pointing out candidates' erroneous or baseless claims. It remains unclear whether the fact-checking journalism movement coalescing in the U.S. (Lowry, 2017) will produce substantial political costs for presidential candidates who habitually make untrue or baseless claims. But as the movement gains traction, understanding how voters react to media coverage of candidates' honesty levels could become more important to predicting and explaining election results. Research on voter attitudes toward overtly corrupt political leaders suggests that some voters lack or disbelieve information about a leader's corrupt activities, while other voters willingly tolerate corrupt activity if they perceive the leader as strong enough to deliver desirable political outcomes (Winters & Weitz-Shapiro, 2013). This paper investigates whether similar processes might have played out among voters who factored candidate honesty into their choices during the 2016 U.S. presidential election. Applying process modeling (Hayes, 2013) to data from the initial ANES 2016 Time Series study release, the paper finds that some Republican voters supported Donald Trump partly because they considered him honest. Others, though, supported him partly because they both considered him a strong leader and approved of a strong leader who "bends the rules to get things done." Similarly, some Democratic voters supported Hillary Clinton partly because they considered her honest, and others supported her partly because they considered her a strong leader. However, this latter group of Clinton supporters disapproved of a strong leader who would bend the rules to get things done. The results suggest that refined operationalizations of these attitudes could help model how voters react to candidates' honesty levels.

Solar Boat Team: An Alternative to Gas

Christopher Winfrey, Graduate student, Engineering Technology; Saeed Foroudastan (Faculty sponsor) Professional Science

The Solar Boat team competes on an international level to develop a vehicle propelled by a sustainable alternative to gas-powered motors. Rather than burning fuel, the goal is to capture solar radiation from the sun to produce voltage, which then charges the batteries being used to power the electrical motors that propel the boat. The students invest countless hours into developing a solar-powered boat capable of competing against other teams from around the world in the Solar Splash competition. They research hull shapes and battery types to maximize speed while draining the batteries at a sustainable rate. The hull and all necessary electronics are chosen by students to create the most aerodynamic design possible. This competition presents an important concept, because in a world utilizing various sources of nonrenewable energy sources, developing an aquatic vehicle utilizing a renewable energy source takes steps towards a more environment-friendly alternative. The development of the vehicle requires knowledge of electrical circuitry and how various components interact. It provides students with a testing area for all the knowledge they gain with their education. The current model in development has recently completed the design of its motor assembly and lower unit in preparation for testing. The design will face its ultimate test during the competition in June.

Production of a Dual-Genre EP

Schiller Poland, Graduate student, Recording Industry; Daniel Pfeifer (Faculty sponsor)
Recording Industry

Abstract: Working with artist Drake VonKohn (Stage name: Drake Freeman), this production will break from traditional methods of producing a single style for a single artist's release and instead consist of two different genres: Southern Rock and Traditional Country. The concept for this project is to produce one artist, record 2 collective works consisting of songs related to different genres and produce them to be viewed together as a whole. The purpose behind this is to explore the full abilities of an artist, experiment with different treatment, recording and production approaches and discover how to create a wider range of work from a single artist. This will emulate the transition that artists go through when they depart from their usual style, while maintaining their identity.

Summary: Pre-production began with research into the musical hallmarks of various musical acts; including Johnny Cash, Willie Nelson, Allman Bros, etc. After a thorough examination of previous recordings, production began with recording Drake with a line of country musicians to record 5 traditional country songs. Once completed, Drake was recorded with a different line of musicians to track 5 southern rock songs. Drake wrote 2 songs to be adapted for each genre, and wrote 3 songs specific to each genre, for a total of 10 songs. The songs for each genre were tracked with the instrumentation and production approach for their specific "sound" and different mixing techniques were also applied to achieve contrast between the two styles. The songs will be compiled into a two-disc EP, currently untitled, and will be released to the public.

Development of a Protein-Based Assay for Discovering Potential Immune Complex (IC) Inhibitors

Matthew Fuller, Graduate student, Molecular Biosciences; Anthony Farone, Faculty, Biology; Elliot Altman (Faculty sponsor) Biology

Immune complex (IC) refers to the molecule resulting from the binding of an antibody to its target antigen. While integral to the immune system's ability to fight infection, IC accumulation in tissues can also become problematic if they are not cleared out by immune cells. IC deposition is associated with Type III hypersensitivity and several serious autoimmune diseases, such as systemic lupus erythematosus (lupus) and rheumatoid arthritis. Therapeutic compounds which inhibit the formation and binding of IC represent a method of treatment for these diseases. Our lab is interested in how IC inhibitors interfere with the interaction between the Fc (fragment, crystallizable) region of the antibody-antigen complex and Fc receptors, which can be found on the surface of immune cells. Compounds which inhibit this interaction show promise as potential therapeutics against IC-related disorders. To that end, we have developed a protein binding assay to be used to screen for compounds which inhibit this interaction, using a known peptide IC inhibitor (NB406) as a reference. The results of this study will serve towards the understanding and development of treatment avenues for IC-related autoimmune diseases such as lupus and rheumatoid arthritis.

Effect of Light Photoperiod on Lipids of the Harmful Marine Dinoflagellate, *Karenia brevis*

Shelby Lowrie, Graduate student, Biology; Hanna Houle, Visiting scholar, Biology; Christian Devine, Undergraduate student, Biology; Jeff Leblond (Faculty sponsor) Biology

Karenia brevis and *Karenia mikimotoi*, well known harmful dinoflagellates that can cause toxic blooms, were utilized to test the effects of photoperiod (*i.e.* time period during a daily circadian rhythm) and high irradiance (*i.e.* bright sunlight) on the chloroplast-associated galactolipids mono- and digalactosyldiacylglycerol (MGDG and DGDG, respectively). MGDG and DGDG are the main lipid components of chloroplasts which are conserved across cyanobacteria and green algae through to vascular plants.

The photoperiod experiment was carried out within a 14/10 day/night cycle and had triplicate samples harvested in 6 hour intervals, including the dark time of the cycle. The irradiance experiment was completed by creating a water bath and maintaining a 20°C temperature while under a high-intensity greenhouse incandescent lamp with an irradiance of approximately 230 $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$ (referred to as high light or HL). Along with this, a set of triplicates of each strain were placed under a shade to reduce the irradiance to approximately 50 $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$ (referred to as high shaded light or HSL).

Results in the photoperiod experiment showed *K. brevis* had a significant difference in 18:1/16:0 DGDG and 18:5/14:0 MGDG intensity at different time periods. The irradiance experiment for *K. brevis* showed three DGDG species were two-fold higher under the HL condition than the HSL condition. *K. mikimotoi* showed no significant changes in the photoperiod experiment, though the irradiance experiment showed significant differences between HL and HSL conditions between many different galactolipids.

Synthesis and Biological Screening of Peracetylated β -D-glucopyranosyl Aurones and Aurone Glucosides.

Arjun Kafle, Graduate student, Molecular Biosciences; Scott Handy, Faculty, Chemistry; Scott Handy (Faculty sponsor) Chemistry

Aurones are categorized as a minor sub-class of the large flavonoid family based on their low abundance in the nature compared with other flavonoids. They are widespread among the plant kingdom. Along with their primary function of imparting color to flowering plants, thereby attracting pollinators for seed dispersal, they have been reported to exhibit a phytoalexin role against various pathogenic infections in plants. Beyond plants, these secondary metabolites have been reported to exhibit a wide range of bioactivity making them a promising therapeutic heterocyclic scaffold in the field of drug discovery. Their broad spectrum of bioactivity, including antimicrobial, anti-inflammatory, antioxidant, antiviral, and anticancer properties have been widely explored. Various substituted glycosylated aurones have also been isolated from plant sources, including aurisidin and sulfuretin-6-O-glucosides. To date, the study of glycosylated derivatives has been limited to only a few naturally occurring ones and no syntheses have been reported. Inspired by this gap, a series of peracetylated glycosyl derivatives of aurones were synthesized by reacting 2,3,4,6-tetra-O-acetyl- α -D-glucopyranosyl bromide with various synthetic aurones in the presence of tetrabutylammonium bromide (TBAB) as a phase transfer catalyst. Although the reaction suffers from a long reaction time, the desired compounds were obtained in moderate to good yield. The thus obtained peracetylated glycosyl aurone derivatives were further deacetylated to synthesize a number of aurone glucosides. Both the peracetylated glycosides and aurone glucosides synthesized were further subjected to various biological screening to study the effect of the glycosyl moiety on the biological activity of aurones.

Incremental Learning for Supervised Dimension Reduction

Ning Zhang, Graduate student, Computational Science; Qiang Wu, Faculty, Mathematics; Qiang Wu (Faculty sponsor) Mathematics

Supervised dimension reduction is an effective tool for high dimensional data analysis. It enables easy visualization of the data and improves the predictive power of subsequent analyses by other statistical machine learning algorithms. As high dimensional and big data become ubiquitous in modern sciences, it is necessary to develop fast and dynamic supervised dimension reduction methods. Sliced inverse regression (SIR) is a pioneer tool for supervised dimension reduction. It identifies the effective dimension reduction space, the subspace of significant factors with intrinsic lower dimensionality. While the good performance of SIR and related refined SIR algorithms have been proved in batch learning, in this paper, we propose to apply the SIR algorithm to incremental learning. The new algorithm, called incremental sliced inverse regression (ISIR), is able to update the effective dimension reduction space as a new observation is accepted. We show that such incremental procedure has the potential to identify the information contained in the new observation while saving the computational time and storage. We also prove the convergence of ISIR algorithm and verify its effectiveness by simulations and real applications.

Fourier Spectral Exponential Time Differencing Methods for Multidimensional Space-Fractional Reaction-Diffusion Equations

Saham Alzahrani, Graduate student, Computational Science; Abdul Khaliq, Faculty, Mathematics; Abdul Khaliq (Faculty sponsor) Mathematics

We propose two numerical methods for solving the space- fractional reaction-diffusion equations, which are based on a Fourier spectral approach in space and exponential time differencing schemes in time. The advantages of the approaches are that they attain spectral convergence, produce a full diagonal representation of the fractional operator, and the extension to multiple spatial dimensions is the same as the one- dimensional space. That can overcome the constraints associated with many of the numerical schemes for these equations such as the computational efficiency caused by the non-locality of the fractional operator, which results in full, dense matrices. Moreover, The proposed schemes are second-order convergent, unconditionally stable, and highly efficient due to the predictor-corrector feature when comparing them with the existing method. It is observed that the scheme based on using Padé (1,1) approximations to the matrix exponential function introduces oscillations with non-smooth initial data for some time steps due to high-frequency components present in the solution which diminish as the fractional order decreases. However, the scheme based on Padé (0,2) approximations to the matrix exponential function is oscillation-free for any time step. Numerical experiments for well-known models from the literature are performed to show the reliability and the effectiveness of the proposed methods.

“He Deserves a Face”: Rewriting the Narrative of Ascent in African American Fiction for Young Adults

Kimberly Feher, Graduate student, English; Laura Dubek (Faculty sponsor) English

Jason Reynolds and Brendan Kiely published their young adult novel *All-American Boys* in 2015 at the height of the Black Lives Matter Movement. Walter Dean Myers published his highly awarded, YA novel *Monster* in 1999 as the world was in the grips of the War on Drugs. Both intersectional texts were written with the intention of being didactic and political social commentary. I will use Robert Stepto's theory of the narrative of ascent as a framework for exploring the intersectional nature of these novels. In his landmark study of African American Literature, *Behind the Veil* (1979), Stepto defines the narrative of ascent as a quest in which the protagonists move from the geographical/metaphorical South (slavery) to the geographical/metaphorical North (relative freedom) to become articulate survivors. I propose that Reynolds, Kiely, and Myers use and subvert the narrative of ascent to portray specific lessons to dual audiences; Reynolds/Kiely follow the traditional story line to uplift their audiences, calling them to action against systematic racism, while Myers subverts the narrative to create a cautionary tale. I will prove my hypothesis through a close reading of the YA novels and a close reading of texts from Frederick Douglass and Richard Wright in order to compare traditional to contemporary uses of the narrative of ascent. Though Stepto's work has been applied to adult African American literature, it has yet been utilized to understand the work of Reynolds, Kiely, or Myers. My project will therefore challenge assumptions about YA Literature, drawing attention to its significant literary merit and relevancy. My audience consists primarily of educators looking to teach complex, high interest texts; scholars studying intersectional literature; or anyone interested in the portrayal of systematic racism in art.

Degradation of Selected Hazardous Organic Compounds by Chlorine Dioxide and Ozone

Md Abdul Hoque, Graduate student, Chemistry; Ngee Chong, Faculty, Chemistry; Ngee Chong (Faculty sponsor) Chemistry

The purpose of this project is to evaluate the feasibility of using chlorine dioxide (ClO_2) and ozone (O_3) to degrade selected hazardous chemicals via the characterization of their reaction products. The techniques of infrared spectrometry with a 10-meter gas cell and gas chromatography coupled to mass spectrometry (GC-MS) were used to study the gas phase degradation process of 1-bromopropane (1-BP), dimethyl trisulfide (DMTS), 2,3-butanedione, isoprene, and 1,1,2-trichloroethane. The degradation rate of DMTS was significant with the initial concentrations of DMTS being reduced to 9.6% by ClO_2 in 10 minutes and to 24.9% by ozone after 60 minutes of reaction time. Ozone was more efficient than ClO_2 in breaking down 2,3-butanedione and isoprene. The initial concentrations of 2,3-butanedione and isoprene were reduced to 68.4% and 21.9% in 40 minutes and 50 minutes, respectively, by ozone. In contrast, 2,3-butanedione was reduced to 75.7% after 40 minutes by chlorine dioxide. Both 1-bromopropane and 1,1,2-trichloroethane were moderately oxidized by both oxidants. The degradation of DMTS by ClO_2 produced many by-products like formic acid, alkyl halide, sulfur dioxide, and dimethyl sulfonate whereas treatment with ozone produces acetic acid and sulfur dioxide. For 1-BP treatment with both ozone and ClO_2 , the same principal byproduct of bromomethane was formed. The degradation rates of these compounds are dependent on the initial concentrations and their ratios to the chlorine dioxide and ozone concentrations.

Mercury Dynamics in Headwater Streams of Tennessee's Appalachian Mountains

Connor Olson, Graduate student, Biology; Gale Beaubien, Graduate student, Biology; Jaylen Sims, Undergraduate student, Chemistry; Andrew Todd, Undergraduate student, Biology; Ryan Otter, Faculty, Biology; Ryan Otter (Faculty sponsor) Biology

While the Appalachian Mountains of Tennessee are often thought of as pristine due their isolation from known point-source contaminants, their elevation makes them susceptible to high levels of contaminant deposition. In particular, mercury deposition has been measured at concentrations $>10 \mu\text{g}/\text{m}^2/\text{year}$, raising potential concerns for human and wildlife health. Tennessee's Ecologically At-Risk Streams – Appalachian Mountain (TEARS-AM) is a three-year study designed to determine the variability across and the susceptibility within four naturally-reproducing eastern brook trout (*Salvelinus fontinalis*) streams spanning the latitudinal gradient of Tennessee's Appalachian Mountains. To determine mercury exposure at these sites, eastern brook trout were collected and analyzed for mercury during the summer of 2015 along with seasonal mercury in water. Although the average concentration of mercury in water was 0.0001 ppb, the maximum concentration of mercury in whole-body fish homogenates (97 ppb) approached threshold values for piscivorous mammals (100 ppb). To better understand mercury dynamics at these sites, the following year additional aquatic biota were collected alongside brook trout and analyzed for mercury. Presented here are the results of mercury in water and biota from 2015 and 2016.

Emission Profile of Biodiesel Blends with Various Oxygenated Additives

Saidi Abdulramoni, Graduate student, Chemistry; Ngee Chong, Faculty, Chemistry; Beng Ooi, Faculty, Chemistry; Ngee Chong (Faculty sponsor) Chemistry

Biodiesel was produced using ultrasonic-assisted transesterification of soybean oil and methanol catalyzed by CaO derived from oyster shell. The reaction yield of 98.5 % biodiesel was achieved in a reaction time of 30 minutes. The biodiesel was blended with petroleum-based diesel and different oxygenated additives including triacetin, diglyme, triglyme, and solketal for emission testing. Fourier Transform Infrared Spectrometry (FTIR) and gas chromatography coupled to mass spectrometry (GC-MS) were used for the analysis of the emission profiles of the biodiesel blends. Each blend was prepared to have the same oxygen content as B20 or B40. The blend showing the greatest reduction in carbon monoxide contained 86.51 % diesel, 2.68 % solketal and 10.81 % biodiesel while the B40 showed the highest reduction in the levels of propene and benzene. Glycerol which is the by-product produced by transesterification reaction will be converted into solketal. The cold flow properties and fuel stability for the biodiesel blended with diesel and other biomass-derived fuel additives are also evaluated.

Huffman Encoded T9 Based Electromyographic Text Input System

Daniel Lewis, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

Being unable to use a computer due to disability can be isolating and economically difficult. While no solution for accessible user interfaces is universal, much of the research has focused on gesture based systems that recognize electromyographic (EMG) signals in the arm or face. In such systems, sensors that can detect electrical activity in response to muscle stimulation are placed on the skin. Unfortunately, these systems typically have problems with noise and shifting of the sensors. Also, due to the size of the muscles that control these gestures, the sensors must be placed with high levels of precision.

This research will aim to show a system that uses only two sensors which can be placed on the forearms by an untrained person. The inputs from these sensors will be conveyed in a modified Huffman code in order to reduce the amount of inputs required. The codes will be used to select a grid in a mobile phone style T9 system. Visual feedback, in the form of a simple color coded graphic, will help the user navigate the tree. The system we will present allows a user to choose a letter in only 4 inputs in the worst case, 2.91 in the average case, and 2 in the best case.

Race and (Mis)Representation: *The Cosby Show* and the "Perfect" Black American Family

Michael Curtis, Graduate student, Communication Studies and Organizational Communication;
Laura Dubek (Faculty sponsor) English

During its eight-year run from 1984-1992, *The Cosby Show* earned numerous awards, most notably the Primetime Emmy Award for Outstanding Comedy Series and multiple NAACP Image Awards. Its creator, Bill Cosby, became the first African American to star in a weekly dramatic television series in 1965 with his role on *I Spy*. This project explores how the African American family was portrayed in the 1980s by analyzing specific scenes, quotes and characters in *The Cosby Show*. My examination of this immensely popular TV narrative will be informed by reviews, articles in magazines and scholarly journals, documentaries, and biographical research on the actor that played "America's favorite dad," Bill Cosby. The primary methodology will be a literary analysis. While critics claim the Huxtable family was not an accurate depiction of an authentic African American experience during that time period, *The Cosby Show* and its representation of blackness had a profound impact on black viewers. My research will try to determine why the images portrayed in this phenomenally popular TV show had such mass appeal. The audience for my project includes anyone interested in African American studies, representation, popular culture or Bill Cosby.

A Continuous Label-Free Cell Separation Device Combining Microfluidics and Dielectrophoresis

Courtney Riley, Graduate student, Professional Science; Charles Perry (Faculty sponsor) Engineering Technology; Tae Hyun Kim (Faculty sponsor), Electrical engineering, University of Michigan

Circulating tumor cells (CTCs) shed from metastatic or primary cancers and have been found in the peripheral blood of patients. Isolation and quantifications of CTC's are important for further research, and clinical applications, such as prognosis and measuring the responses to treatments. Current methods of CTC separation are expensive, lack efficiency, and restrict post-capture processes. There is only approximately one CTC for every 10⁹ hematologic cells. By combining size and dielectrophoretic (DEP) separation CTCs can be successfully separated from blood samples. A microfabricated filter with pore size of 8 μm is used to separate the CTCs based on size. The use of a device with spiral shaped micro-channels can efficiently separate CTCs from a patient's blood sample. CTCs have an approximate diameter of 15 to 20 μm (erythrocytes are 7 ~ 10 μm biconcave disks and peripheral blood lymphocytes are 7 ~ 10 μm). Preceding the spiral channel, DEP is utilized to isolate the cancer cells even more precisely. Using DEP also assists in avoiding cell clogging at the outlet of the device. A non-uniform electrical field creates DEP forces. An attractive force that is only sufficient enough for large cells is used to guide CTCs to exit through one outlet while the white blood cells continue to flow through the other two outlets. The combination of size separation and the use of DEP allow for separation without labeling and ensure a high precision, separation of cancer cells from the blood sample. Because no labeling is used, post-capture processes may be completed.

Predicting the Receipt of a Physician's Recommendation for a Lifestyle Change

Sarah Murfree, Graduate student, Health and Human Performance; Garvita Thareja, Graduate student, Health and Human Performance; Norman Weatherby (Faculty sponsor) Health and Human Performance

Heart disease is the leading cause of death for men and women in the United States. Lifestyle factors such as a diet high in cholesterol, saturated fat and/or sodium, physical inactivity, and obesity increase the likelihood of developing risk factors for heart disease. In 2013, AHA and ACC issued a practice guideline document which advised healthcare providers to recommend lifestyle changes for adults with risk factors for heart disease. Effective communication from healthcare providers including recommendation for lifestyle changes is an important aspect of the quality of healthcare.

The purpose of this study was to examine the relationship between receiving a recommendation for a lifestyle change from a doctor and receiving a prescription for a cholesterol-lowering medication. A logistic regression used data for persons above age 34 from the 2015-2016 *National Health and Nutrition Examination Survey* (NHANES).

When controlling for gender, race/ethnicity, education level and age, persons who were told to take a cholesterol-lowering medication were more likely to receive a recommendation for a lifestyle change than persons who were not told to take a cholesterol lowering medication. Women were more likely than men to receive a recommendation for a lifestyle change from their doctor. Mexican-Americans, other Hispanics, and non-Hispanic Blacks were more likely than Non-Hispanic Whites to receive a recommendation for a lifestyle change. Persons with a less than 9th grade education were more likely than persons with at least a college degree to receive a recommendation for a lifestyle change.

Disparities in healthcare, including differences in physician communication, are well documented. This study identifies differences in receipt of recommendations from doctors for a lifestyle change to lower the risk for heart disease by gender, age, race/ethnicity, and education level.

The Pathogenic Yeast, *Cryptococcus neoformans*, Promotes M2 Polarization of Host Macrophages by Down-regulating p53 Signaling

Linda Sircy, Graduate student, Biology; Kirsten Cunningham, Undergraduate student, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Erin McClelland, Faculty, Biology; David E. Nelson, Faculty, Biology; David Nelson (Faculty sponsor) Biology

Cryptococcus neoformans (*Cn*) is a fungal pathogen that is a leading cause of mortality among the immunocompromised, causing ~181,000 deaths each year worldwide. *Cn* infections usually begin as acute pulmonary infections that can progress to fungal meningitis. However, *Cn* can also establish long-lasting chronic infections by residing inside host macrophages, circumventing the host immune response to re-emerge decades later. However, the mechanisms *Cn* utilizes to avoid destruction by host macrophages are poorly understood. Many intracellular pathogens are able to attenuate the innate immune response by compromising macrophage activation/polarization, 'pushing' host macrophages from a classical (M1) state towards the alternative (M2) state. This is perceived to be an effective strategy because while M1 macrophages exhibit enhanced microbicidal activity and are typically associated with favorable clinical outcomes, M2 macrophages are less able to destroy ingested pathogens. While the effect of *Cn* on macrophage polarization has yet to be fully explored, the ability of *Cn* to exploit macrophages as a growth niche would indicate that they are capable of interfering with the processes that govern polarization, attenuating the microbicidal activity of these host cells. To comprehensively test this hypothesis, we utilized an RNA sequencing-based approach to assess the impact of *Cn* infection on the transcriptome of M1-polarized macrophages. Our data suggests that intracellular *Cn* disrupts macrophage polarization as key M2 genes were upregulated in infected cells. Using gene ontology and pathway analysis, we were able to show that intracellular *Cn* decreased the activity of the p53 pathway, a negative regulator of M2 polarization. We found that p53-transcription factors were downregulated in *Cn*-infected cells, effectively disinhibiting M2 gene expression. This was reversible by treating cells with Nutlin-3a to stabilize p53. Together, these data provide powerful new insights into the mechanism by which *Cn* evades the innate immune response to survive long-term within host cells.

An Evaluation of GPU Implementations of SSSP and APSP Algorithms

Charles Johnson, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

As graphics processing units (GPUs) are increasingly being utilized as coprocessors and/or program accelerators for graph problems, more and more algorithms and implementations thereof are being proposed. One problem is that when researchers benchmark their algorithms and/or implementations against a purely CPU-based solution, the hardware being used widely varies. Accordingly, one cannot, based on published results alone, actually compare a given algorithm and/or implementation that relies on a GPU to another such algorithm. The purpose of this project is gather together implementations of multiple single source shortest path (SSSP) and all-pairs shortest path (APSP) algorithms that utilize GPUs and compare them using a single test machine. Due to NVIDIA's dominance as being the manufacturer of choice for those incorporating GPUs into their programs, all testing will be done using an NVIDIA GPU and their CUDA API. The results of the tests, which will be performed using at least two different graphs (one dense, one sparse) for test input, will then be plotted and displayed, so as to allow for comparison.

From Cure-alls to Calcium Tablets: a Comparative Semiotic Analysis of Advertisements for 19th-20th Century Patent Medicines and Contemporary Dietary Supplements

Karin Albrecht, Graduate student, Media and Communication; Jane Marcellus (Faculty sponsor)
Journalism

Created as a Master's thesis for the Media and Communication program, this research explores American advertising with a focus on health and medicine. In America today, ads are integrated into the fabric of everyday life, subtly (or not-so-subtly) communicating to and about American culture. While advertising may not necessarily create a society's values, advertisements certainly convey the existing values, tastes, and beliefs within a society; therefore, the way advertisers communicate messages regarding health arguably shapes consumers' conceptions of disease and well-being. This research uses semiotic analysis as conceptualized by Roland Barthes and Ferdinand de Saussure, who viewed communication through the lens of language systems constructed from visual, verbal, and material elements. From this perspective a *sign* is constructed from a *signifier* (the tangible element) and a *signified* (the intangible element, i.e. an idea), with individual signs building on one another to create multiple levels of meaning within a communication text (in this case, advertisements). While comparing the signs in advertising for both 19th and early 20th century patent medicines and contemporary dietary supplements, this analysis explores the historical context of each era. This includes the history of American medicine, American advertising, and changing Federal regulations as well as an exploration of messages within the ads, the signs used to convey those messages, and the broader myths (cultural ideas) that those signs construct. These myths connect health and well-being to power, nature, and the idea of "the good life" in American culture as it has evolved over the past 150 years. While examining these signs within American history, significant differences have emerged, but also enduring truths that demonstrate how the nature of people remains surprisingly familiar through the decades.

“Ships At a Distance”: Spike Lee’s Intersectional Treatment of Female Sexuality

Elizabeth Carpenter, Graduate student, English; Laura Dubek (Faculty sponsor) English

Spike Lee’s films have become a lightning rod of cultural criticism. While some laud him as a progressive and even feminist artist, others contend that his work does more harm than good—particularly in regards to representations of African-American women. Much scholarship has already tackled this issue, but few critics have considered the intersection between Lee’s treatment of sexual stereotypes and his employment of extratextual literary references. In *She’s Gotta Have It*, for example, Lee references Zora Neale Hurston and constructs a parallel between his character Nola and Hurston’s protagonist Janie. Such literary intersections recur throughout Lee’s filmography and create yet another layer that must be considered when discussing Black female sexuality in his work. My research considers what Lee achieves by invoking such literary traditions, and whether doing so serves to confirm or deconstruct stereotypes of African American women’s sexuality. To answer this question, I will analyze several of Lee’s films—including *She’s Gotta Have It*—as well as the correlating literary work. Through this analysis, I aim to demonstrate that Lee’s depictions of Black female sexuality—and feminine sexuality in general—are at once subversive and normative: while he often creates characters who counter the typical narratives imposed on Black women, he also reinforces such narratives by punishing those characters for their deviant actions. When viewed in the context of Lee’s literary allusions, the implications of this dichotomy become even more complex. Analyzing the respective layers of these works will illuminate the greater position of Black women in pop culture, the persisting stereotypes of their sexuality, and the function of intersecting film and literature in approaching such stereotypes. The culmination of my research will be an intersectional contribution to fields such as gender studies, language and literature, race studies, and popular culture.

The Evolution of Jazz Recording Techniques

Tevin Turner, Graduate student, Recording Industry; Michael Hanson (Faculty sponsor)
Recording Industry

This study investigates the evolution of small ensemble jazz recordings by examining the production, recording, and mixing techniques of the past and present to plot the unwritten future for jazz/pop fusion records. The purpose is to use the discipline and methods of traditional and contemporary jazz records as the basis for helping develop the future sound of jazz/pop fusion. To supplement this research and complete this project, I will act as co-producer, lead tracking engineer, and lead mix engineer for the EP entitled *The Southside Mosaic*.

First, by choosing three popular jazz standards covered by notable jazz artists such as Helen Merrill, Miles Davis, and June Christy, I will record and mix three new original jazz versions of the selected jazz standards using the production, recording, and mixing techniques of contemporary jazz records. I will focus on the current technology and methods used to craft the sound of modern jazz records.

Next, I will record and mix three new original jazz versions of the jazz standards using traditional production, recording, and mixing techniques from the 50s and 60s. I will research the methods of the 50s and 60s and analyze how the limitations of the recording technology affected the sound of traditional jazz records.

Finally, I will co-produce, record, and mix the three selected jazz standards into three new jazz/pop fusion covers. The jazz/pop fusion covers will incorporate the traditional and contemporary techniques of jazz records utilizing the song structure, production, recording, and mixing methods of pop records. I will reference the work of modern artists like Norah Jones, Robert Glasper, and Esperanza Spalding who have had success blending jazz music with pop production techniques.

Genetic Variation of *Cryptococcus neoformans* Dependent upon Host Environment

John Shahan, Graduate student, MSPS-Biotechnology; Erin McClelland (Faculty sponsor) Biology

Introduction: *Cryptococcus neoformans* is a fungal pathogen that causes opportunistic infection in immunocompromised patients; especially those with HIV/AIDS. Of that population there are approximately 220,000 cases of cryptococcal meningitis worldwide resulting in nearly 181,000 deaths per year. Previous research has shown that the infection ratio of *C. neoformans* is ~70:30% male to female despite equal exposure ratios. This current project seeks to understand this disparate infection ratio at a genetic level. **Methods:** Previously microarray data has revealed differences in genetic expression of *C. neoformans* isolated from males and females. RNA extractions were performed on clinical strains isolated from males and females and then sequenced using RNA sequencing. A list of genes was obtained and qRT-PCR was performed to verify the RNA-Seq data. Upon verification, knockout strains were obtained for the specific genes. Currently phenotypic testing is being performed to determine if there are differences in melanization, growth in the presence of peroxide, and capsule size. **Results:** RNA-Seq data revealed differences in expression ratios of the following genes: CNAG_04357, CNAG_02849, CNAG_00867, CNAG_03082, CNAG_05983, CNAG_01040, CNAG_08026, and CNAG_03477. qRT-PCR was performed on 3 male and 3 female clinical strains to verify the RNA-Seq data. Knockout strains were available for CNAG_02849, CNAG_01040, CNAG_03082, and CNAG_04357. Preliminary melanization data reveals disparate melanization ratios for the knockout strains when compared to H99S, with an overall trend of delayed melanization in the knockout strains. **Discussion:** The combination of the RNA-Seq data as well as the phenotypic assays suggest that *C. neoformans* undergoes differential genetic expression depending upon the environment that the microorganism is attempting to colonize, which may help explain the increased incidence of disease in males.

Personalized Web Search Based on User Interaction with Browser

Vishwajith Shivanandaih Matad, Graduate student, Computational Science; Suk Jai Seo (Faculty sponsor) Computer Science

As the World is evolving rapidly so do the people using computers, in the present situation we have billions of people using computers and internet each day. People using computers differ from small kid to Ph.D. holder, however, the search engine often throws up the same results for everyone on the same query. So, the personalized search engine has emerged solution for this problem. However, personalized search is still a challenge, even though we have different strategies to accomplish personalized search in present strategies are still struggling to get the perfect results, many false positive and false negative results are popped on search.

In this paper, we propose an approach to minimize the false positive and negative results by combining two well-known strategies click through and profile based personalized search, in addition building a client-side application which records a different kind of data of user interaction with the web, like time user spends on specific web pages, keywords entered and click through information. Combining all this we will build a hierarchy of user favorite category and retrieve the personalized search results according to hierarchy. In the end, we demonstrate the effectiveness of our strategy over the contemporary solutions, by comparing the results with similar strategies like click through and profile based personalized search.

Keywords: Personalized search, Click through Personalized search, profile-based Personalized search.

An Examination of the Relationship Between Diabetes and Risk Factors Including Diet, Physical Activity and Body Weight Among US Adults

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Introduction: Diabetes is an epidemic in the United States that affects over 30 million adults across the country. Diabetes is a chronic disease that impairs the body's ability to regulate blood sugar levels. The most common form of diabetes is type 2 diabetes mellitus. This form of diabetes can be prevented or delayed through healthy lifestyle changes including diet, physical activity, and body weight. This study examined the relationship between diabetes and risk factors such as diet, physical activity and body weight.

Methods: Data for this study came from the 2016 *Behavioral Risk Factor Surveillance Survey* (BRFSS). Complex samples frequencies were computed and logistic regression was used to model the effect of diabetes on diet [sugar], physical activity, and body weight [BMI].

Results: Participants who report being diagnosed with non-pregnancy related diabetes (10.8%: CI 10.6 -11.0) consume less sugar (OR 0.49: CI 0.48 – 0.54); engage more in non-work related physical activity (OR 1.72: 1.59 – 1.92) but are more likely to be overweight (OR 2.4: CI 1.5 – 4.1) and obese (OR 6.2: CI 3.73 – 10.29) those who have not been diagnosed with diabetes.

Conclusion: Overall the results are encouraging in that post-disease diagnosis, diabetics seem to adopt a healthier lifestyle as part of disease management. However, the results also show that excessive body weight, a risk factor for diabetes, continues to be a problem for most diabetics. Diabetes prevention programs should emphasize effective weight loss techniques and maintaining a healthy body weight.

Expression of a Novel Protein(HVA1) that Affects the Virulence of *Cryptococcus neoformans*

Aarthi Subramani, Graduate student, Molecular Biosciences; Erin McClelland (Faculty sponsor)
Molecular Biosciences

Background: Affecting more than 220,000 people per year and causing 181,000 deaths per year, the fungal pathogen, *Cryptococcus neoformans* (*Cn*) causes fungal meningitis in immune compromised hosts, primarily AIDS patients. There have been several studies stating the importance of proteins/enzymes in metabolism in the virulence and pathogenesis of the fungus. Recently, a new virulence factor (HVA1) was found to have an influence on the pathogenesis of *Cn*. HVA1, a hypervirulence associated protein 1 was found to impede the immune response of the host and contribute to pathogenesis through alteration of metabolism.

Methods: In order to better understand the function of HVA1, and to localize its expression in the cell, the Hva1:GFP fusion is being constructed.

Results: We have successfully inserted half of the construct (5'UTR+HVA1+GFP) into the pAllet plasmid and are currently working to insert the second half (NEO+3'UTR). Once complete, this construct will be used to transform the HVA1 knock-out strain and visualize its location in the cell through confocal microscopy.

Conclusions: Understanding how HVA1 alters metabolism to affect virulence will provide insight into the pathogenesis of this important human pathogen.

The Impact of the Affordable Care Act on Breast Cancer Mortality among African-American Women

Glory Okwori, Graduate student, Health and Human Performance; Norman L. Weatherby, Faculty, Health and Human Performance; Andrew Owusu, Faculty, Health and Human Performance; Norman L. Weatherby (Faculty sponsor) Health and Human Performance

Implementation of the Affordable Care Act (ACA) led to significant increases in insurance coverage and decreased the cost of preventive care. The ACA was enacted in 2010 and major coverage provisions were fully implemented in 2014. Previous studies have shown that the ACA increased breast cancer screening rates and diagnoses; key provisions in the ACA included the mandatory coverage of cancer screening. However, currently there are no empirical studies of the impact of the ACA on breast cancer mortality, indicating an important gap in knowledge. The present study is motivated by this concern and thus seeks to analyze the impact of the ACA on mortality from breast cancer.

Data for the current analyses were yearly age-adjusted death rates for malignant breast cancer (ICD 10 Code C50) for Black or African-American women. The data for 29 states with complete data for 2002-2016 were obtained from the CDC WONDER underlying cause of death database. Generalized Estimating Equations (GEE) in SPSS was conducted as a repeated measures analysis assuming an exchangeable working correlation matrix. The covariate was year, and whether or not the ACA was fully implemented was the categorical predictor of mortality.

Mortality from breast cancer among Black women has been decreasing significantly over time. The Affordable Care Act has begun to have a beneficial effect by further decreasing death rates. More years of data are needed to see significant reductions due to the ACA and not just due to yearly decreases. We expect that continued monitoring of the effect of the ACA will show significant decreases in breast cancer mortality as more women have access to early and affordable screening. Future research can build on this study to evaluate the impact of the ACA on female breast cancer outcomes to inform policy recommendations.

Supporting Biology Lab Instructors to Engage Students in Disciplinary Talk through Professional Development and Curriculum Materials

Zhigang Jia, Graduate student, Mathematics and Science Education; Angela Google, Graduate student, Mathematics and Science Education; Tina Carter, Graduate student, Biology; Anna Grinath, Faculty, Biology; Anna Grinath (Faculty sponsor) Biology

Authentic disciplinary engagement in science practice and discourse is a cornerstone of the current vision of science education for K-16 (AAAS, 2011; NRC, 2012). However, orchestrating disciplinary discourse is a challenge for most teachers (Alozie et al., 2010; Harris et al., 2012; Park et al., 2017), and especially difficult for novice teaching assistants (TAs) instructing postsecondary science laboratories with minimal preparation for this instructional assignment (Gardner & Jones, 2011; Luft et al., 2004). If laboratory TAs are expected to foster disciplinary talk, they need to be supported through professional development (PD) and curriculum materials. While such supports have been described for K-12 teachers, there is a need for research that examines how to support postsecondary TAs to engage students in scientific discourse. To address this need, our study examined an undergraduate biology laboratory course, designed around authentic disciplinary engagement, to explore the question: How are biology lab TAs supported through professional development and curriculum materials?

We used qualitative methods to analyze the data sources (laboratory manual, instructor manual, transcripts of PD sessions). Our a priori codes were grounded in the literature (Davis & Krajcik, 2005). The coding framework remained open through the analysis (Merriam, 2009). Through iterative and collaborative analyses, we classified the codes into themes. Our results aligned with prior K-12 literature that distinguishes between supports for Reflection ON Action and Reflection IN Action (Guess-Newsome, 2015). However, preliminary analyses suggest that the postsecondary laboratory context with weekly TA planning meetings provides unique PD opportunities to connect the rationale of the curriculum design to instruction, to anticipate student thinking around planned discussions, and to model productive talk moves. Future research will examine how TAs engaged with these supports and how that engagement was related to TAs' instructional practice. Our findings have implications for postsecondary biology laboratory education.

Searching for New Game Mechanics Missing from Contemporary Games Aiding Computer Science Education

Jesse Humphries, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

Various games have been created to aid Computer Science Education (CSE), but many of them teach similar concepts using similar game mechanics, e.g. achievement badges and drag-and-drop controls. Studies on the use of gamified mechanics in the classroom show that certain types of feedback and mechanics can positively affect specific learners while having no impact on others. Therefore, a lack of diverse mechanics could be limiting the effectiveness of CSE games for certain types of learners. By comparing popular educational games to popular mainstream games, using assessment models found in typical research on the subject, it may be possible to synthesize a new area of unexplored mechanics currently underdeveloped in CSE games. The assessment models used in this project include classification of feedback, pedagogical practices, and suggested standards pulled from peer-reviewed research. If any interesting mechanics are discovered, new games built on top of them could make the benefits of CSE games more accessible to a wider audience. The purpose of this project is to discover new mechanics through assessing and comparing games using educational models, and to design a game using those discovered mechanics.

Innovation and Unemployment: Paths of Causality

Bronwyn Graves, Graduate student, Economics and Finance; Anthon Eff (Faculty sponsor)
Economics and Finance

Innovation and unemployment are topics of government discussions, both at the state and federal levels. Government agencies are interested in policies that facilitate innovation, which include spending money to fund innovation-producing research. This paper seeks to understand the connection between changes in innovation, represented by patent data, and changes in unemployment rates in innovation-centric cities across the United States. If patterns of causality among cities in changes in innovation and unemployment exist, they can provide policymakers with a better picture of the best fund allocation. For example, providing government funding for growing innovation cities that positively influence changes in unemployment in other cities would provide exponential returns. Overwhelmingly, the connections among changes in unemployment rates were the most frequent result of my Granger causality regression, meaning that cities are incredibly interconnected in respect to changes in unemployment rates. Conversely, the causality for unemployment rates on patents was the least frequent result—unemployment rates rarely cause changes in patent counts. Though not strongly supporting the interconnection between patent changes and unemployment changes, this paper provides proof that innovative cities themselves are conclusively interconnected.

Cinema's Native Son: The Literary Impact of Oscar Micheaux's Novels and Films

Jess Bennett, Graduate student, English; Shane Levan, Graduate student, English; Laura Dubek (Faculty sponsor) English

When considering the African American literary canon, one finds that a selective amount of attention has been given to black filmmakers, and even then, the bulk of this attention has been granted to artists who got their start in the latter half of the twentieth century, such as Spike Lee and Melvin Van Peebles. Oscar Micheaux, a pioneer African American filmmaker, began directing movies as early as the 1920s. Other black artists of his time found him controversial, because Micheaux feuded with several members of the "black literati" such as W.E.B. DuBois and Richard Wright, going so far as to create parodies of these two writers in his own novels *The Story of Dorothy Stanfield* and *The Case of Mrs. Wingate*. Ultimately, this feuding made his presence in the canon of early twentieth century African American art, especially literature, precarious at best. While recent scholarship has focused on Micheaux's filmography, our project will bring much needed attention to his novels as well as the impact of his films on black literary culture. Despite his problematic relationship with prominent literary figures, Micheaux's work suggests a definite influence during the era. His 1935 film *A Murder in Harlem*, for example, bears many striking resemblances to Richard Wright's watershed novel *Native Son*, published in 1940. Through a close reading of *The Story of Dorothy Stanfield* and *The Case of Mrs. Wingate*, and through a comparison of *A Murder in Harlem* and Wright's *Native Son*, our project will widen the critical lens through which Micheaux and his work are viewed. This project will appeal to those who are interested in film and early film history, literature, intertextual studies, and the African American literary tradition.

The Impact of the Solar Tree with Nanowire Technology

Tasneem AlSalem, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)
Engineering Technology

Solar energy has huge potential, and its usage is growing fast energy sector in the past few years. The photovoltaic conversion of sunlight to electricity is among all the different techniques available to utilize solar energy. Despite its merits, yet it is still viewed with concerns with the usage of large land mostly in urban areas, and the waste of efficiency. Also, it conflicts with public perception because of the absence of pleasant aesthetics. The concept of solar tree can solve these problems, especially the space problem. However, a new idea that can tremendously improve the efficiency of a solar power is by using Nanowire solar cell with the design of the solar tree. Nanoparticles offer many special properties relative to bulk material. Nanowires have high physical light absorption properties, up to 15 times of the normal sunlight intensity. It is an insurgent urban lighting concept that leads to the development of high efficiency of the solar energy. As a result of these properties, the limit of how much energy from the sun each cell can uses is higher than transitional techniques. Hence, the Solar Tree with Nanowire enhances many applications such as streetlights, house supplies and industrial power supplies, where many solar energy companies can be positively impact and grow.

The Effect of Different Fish Predators on Riparian Spider Mercury Concentrations

Gale Beaubien, Graduate student, Biology; Connor Olson, Graduate student, Biology; Ryan Otter, Faculty, Biology; Ryan Otter (Faculty sponsor) Biology

The use of riparian spiders as tracers of aquatic contaminants (i.e. mercury and polychlorinated biphenyls) is limited by complex interactions that can affect the %-contribution of adult aquatic insects assimilated by these predators. The objective of this study was to determine if the presence of different fish predators impact the mercury concentrations in riparian spiders and if mercury measured in these riparian spiders exceed thresholds of concern. Three sites were selected in the Appalachian Mountains; two sites have a barrier separating downstream rainbow trout (*Oncorhynchus mykiss*) from upstream eastern brook trout (*Salvelinus fontinalis*) while the third site has sympatric populations of rainbow trout and eastern brook trout. At each site, spiders were separated by family, homogenized into three samples, and then analyzed for total-mercury (Upstream *Tetragnathidae* THg: 280.7 $\mu\text{g}/\text{kg} \pm 63.1$ SE and *Araneidae* THg: 93.9 $\mu\text{g}/\text{kg} \pm 16.3$ SE; Downstream *Tetragnathidae* THg: 196.7 $\mu\text{g}/\text{kg} \pm 16.6$ SE and *Araneidae* THg: 110.0 $\mu\text{g}/\text{kg} \pm 21.7$ SE). The different fish communities alone do not explain the differential export of mercury to riparian predators. At all sites spiders exceeded mercury risk threshold concentrations calculated for chickadee (*Poecile spp.*) nestlings.

The Ergonomic Impact on Women Working in Construction

Brianna Smith, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)
Engineering Technology

In today's society, where the population of women in the workforce is growing, there is interest in how the impact of doing work that has been historically classified as "men's work" physically affects women doing these jobs. In the construction industry, many women are tasked with job responsibilities that have been predominantly performed by men in the past. Women are naturally and physiologically prone to different health issues than men, so when working in an environment catered to primarily men, it is thought that women are seemingly put at higher risk. The purpose of this study is to investigate the ergonomic impact on women working in an industry dominated by and accommodated to men. This analysis will study how the health of women is impacted by working in the construction industry and suggest potential countermeasures for improving ergonomic issues to create a more comfortable and safe working environment for women.

The Relationship Between Age of Initiation of Alcohol/Tobacco/Marijuana Use and Prescription Drug Abuse Among High School Students in the US

Tandra Gause, Graduate student, Health and Human Performance; Willie Rajvong, Graduate student, Health and Human Performance; Andrew Owusu, Faculty, Health and Human Performance; Chandra Story, Faculty, Health and Human Performance; Bethany Wrye, Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

Purpose: Currently, opioid prescription abuse is considered an epidemic in the United States. Consequences can include opioid related overdoses, increase amount of misuse, or death. This crisis is causing a public health threat because people are sharing syringes and increasing the rates of HIV, hepatitis C, and other diseases. The purpose of this study is to determine if age of initiation of substances (i.e. cigarettes, alcohol, and marijuana) use is related to abuse of opioid prescription medicines.

Methods: Data from the 2015 US Youth Risk Behavior Survey (YRBS) was used. Complex sample frequencies and crosstabulations were computed to determine prevalence estimates and odds ratios.

Results: Overall, students who had their first drink of alcohol before age 13 years are significantly more likely (OR 3.2: CI 2.8 – 3.75) to have ever abused prescription drugs compared to those who initiated drinking at a later age. Similarly, students who initiated smoking (OR 5.1: CI 4 – 6.4) and marijuana use (OR 7: 5.8 – 8.5) before age 13 years are significantly more likely to report prescription drug abuse than those who initiated smoking or marijuana use at a later age.

Conclusions: The positive relationship between early initiation of substance use and prescription drug abuse suggests that delaying the age of initiation of alcohol, tobacco and marijuana use can positively impact efforts to decrease abuse of prescription drugs. Future research should consider examining the direction of the relationship using a longitudinal design.

Broad band Maximum Length Sequence (MLS) Multilayer Dielectric Reflector

Khem Poudel, Graduate student, Computational Science; William Robertson, Faculty, Physics and Astronomy; William Robertson (Faculty sponsor) Physics and Astronomy

Broadband reflector designed by dielectric stacks provide good reflectivity and low absorption in THz and optical region compared to metallic reflectors. The dielectric multilayer reflector is a structure built from a specified combination of high and low refractive index layers on a substrate. We investigate via numerical simulation the design of an alternating multilayer of high (TiO_2) and low (SiO_2) refractive index materials with thicknesses determined by an MLS sequence. Maximum length sequences (MLS) are two level binary sequences that are pseudo-random. An MLS has a uniformly flat frequency response except for a DC offset which indicates that these sequences contain all possible periodicities. We characterize the reflection characteristics of such structures in the visible frequency range. Further, we compare the reflection characteristics of this MLS with a periodic alternating high and low refractive index multilayer. The MLS structure provides a broader band gap compared to a periodic structure due to uniform flat frequency distribution in entire range. The reflection characteristics for broad angle of incident and wavelength for these designs are investigated using rigorous coupled wave analysis (RCWA), transfer matrix, and COMSOL Multi physics finite element simulation.

Analysis of Clinical and Passaged Strains of *Cryptococcus neoformans* Reveals Alternative Splicing in Virulence Genes

Mitch Merryman, Graduate student, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor)
Biology

Alternative splicing allows eukaryotes to produce a larger number of proteins from a limited number of genes. Alternative splicing has also been associated with virulence in pathogenic eukaryotes. To determine if differences in alternative splicing were present and perhaps contributing to the pathogenicity of *Cryptococcus neoformans*, differential gene expression and analysis of alternative splicing was examined in clinical strains of *C. neoformans* compared to a less-pathogenic laboratory strain using RNA sequencing. 91 genes were differentially expressed by 2 fold or more in five or more clinical strains compared to the laboratory strain. Analysis of alternative splicing specifically focused on ten known virulence genes from this dataset revealed alternative splicing for most of these genes. Specific assays for alternative splicing in these regions were then designed and utilized for investigating whether the same or different alternative splicing was observed in *Cryptococcus* strains that were serially passaged in wax moth larvae (*Galleria mellonella*) and mouse (*Mus musculus*). This analysis revealed extensive alternative splicing, mostly intron inclusion, which is a known regulatory mechanism to effectively reduce levels of functional protein by generating premature stop codons. Further studies will need to quantify whether the levels of alternative isoforms differ between the passaged and parent strains, and also to identify novel isoforms found in this study.

Development of an Expert System as a Diagnostic Tool for Diseases

Mohammed Mercy, Graduate student, Computer Science; Dr. Suk Jai Seo (Faculty sponsor)
Computer Science

Having access to medical facilities at all time is essential. Many rural communities have extremely limited access to medical services. People travel long distances to clinics or medical facilities, and there is a shortage of medical experts in most of these facilities. This results in slow service, and patients end up waiting long hours without receiving any attention. Due to these challenges, we plan to implement a medical expert system for diagnosing diseases, hence medical expert systems can play a significant role in such cases where medical experts are not readily available. This work presents the design of a knowledge-based expert system that aims to provide the patients with medical advice and basic knowledge on diseases. The system will utilize a user-friendly interface for users thus, users can diagnose themselves by answering questions provided by the system based on condition and symptoms, it will then help in detecting the related diseases and provide treatment suggestion.

This work presents the design and development of the system, forward chaining rules will be used to implement the knowledge base and the system will be easily accessible on mobile platforms. We plan to use the Java Expert System Shell (JESS) as a tool for its inference engine and the system will be validated by domain experts. This is useful because it helps to maintain anonymity for patients, in addition, the system provide user advises or treatments for diseases in shorter time. By constantly maintaining and updating the knowledge base, the system has a potential application in medical practice.

Wild-Simulated Production Guide for Ginseng Farmers in Tennessee

Shannon Smith, Graduate student, Molecular Biosciences; John DuBois, Faculty, Biology;
Nathan Phillips, Faculty, Agribusiness and Agriscience; John DuBois (Faculty sponsor) Biology

Asian ginseng (*Panax ginseng*) is a fleshy root plant that has been used for millennia in Asian medicines. American ginseng (*Panax quinquefolius*) is the North American cousin to the Asian species and both are members of the ivy family. Both the Asian and American species have been valued throughout history, and collected or cultivated for use. The demand for ginseng is highest in the Eastern markets. To meet this demand, both farmers and wild ginseng harvesters have increased output to leverage a growing far-eastern economy. Agricultural scientists have been researching methods to aid farmers in their production of American ginseng. The goals of this paper are (1) to summarize the research of several specialists into one coherent narrative; and (2) to give agricultural producers in Tennessee a working understanding of several variables that affect the growth and value of North American ginseng. By focusing on the wild simulated method, information from a diverse set of disciplines can be delivered to the public in a fashion that allows for its practical use. Also, switching production of ginseng for human consumption from harvesting dwindling wild sources to wild simulated methods can lessen harvest pressure on threatened populations.

Voting Versus Average

Honglan Xu, Graduate student, Mathematics; Qiang Wu (Faculty sponsor) Mathematics

In this paper, we will compare two methods of calculations for the classification of some different detailed problems. The objective of this project is how to classify the information properly and efficiently. As far as we know, distributed learning is an effective method to process big data, which partitions a data set into multiple disjoint data subsets. In addition, I apply the support vector machine (SVM) algorithm with a general kernel and logistic regression algorithm to each data subsets to produce an output function. One method (“Voting”) is to take the signs for each function and then average them. The other one (“Average”) is to average these functions learned from these subsets to capture a new function that represents the whole and then take the sign of the new one to classify the issues. I derive the accuracies of these two algorithms and use the t-test to obtain a p-value to examine them. I come to a conclusion that “Average” is better for classification and gives the better learning rate.

Describing Physical Activity Breaks During the School Day: A Preliminary Analysis

Monica Hill, Graduate student, Elementary and Special Education; Kathleen Burriss, Faculty, Elementary and Special Education; Larry Burriss, Faculty, Journalism; Donald Snead, Faculty, Educational Leadership; Kathleen Burriss (Faculty sponsor) Elementary and Special Education

Prior research clearly describes the positive relationships across children's play/physical activity and mental wellness, physical health, and intellectual success. This mixed- method study identifies ways in which classroom teachers reported implementing physical activity and play opportunities during the typical school day. Classroom teachers (N=500), pre-K through sixth grades, completed surveys identifying the types of play and physical activities (recess, movement) implemented during the day, time allowed for each type of experience, use of software to support movement, and training associated with physical activity and play. Data revealed categories of physical activity, play, and games. Data evidenced teachers' pervasive use of GoNoodle as an activity break during the schoolday. Findings support previous research demonstrating diminished time allowed for children's recess. Finally, data suggest teachers lack adequate training to understand and effectively implement developmentally appropriate physical activities and play experiences for children. In this era of high-stakes testing, concerns for childhood obesity, and long sedentary hours in classrooms, authors discuss the implications of this study for children's long-term health and wellness. Recommendations describe the importance of ongoing professional development in the areas of physical activity and play as integral for children's life success as are any other subject areas.

Misconceptions of Mutations and Pedigree Analysis Reveal Lack of Depth in and Reliance on Misplaced Intuition on Understanding

Zachary Grimes, Graduate student, Mathematics and Science Education; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

Biology education is currently undergoing reform efforts to increase student retention and appreciation of biological sciences. Specifically, this reform calls for the use and evaluation of evidence-based instructional strategies to support learning in biology courses. Integration of evidence-based instructional strategies requires instructor familiarity with student misconceptions and conceptions. Concept inventories are assessments aimed at illuminating student misconceptions and effectiveness of learning activities. The current study, which focuses on mutations and pedigree analysis, is part of a larger study to develop concept inventories for five pivotal genetics concepts. This project sought to understand students' misconceptions of mutations and pedigree analysis to aid in concept inventories development for these concepts. The guiding question for this inquiry was: What misconceptions about mutations and pedigree analysis do undergraduate biology majors hold? Responses to open-ended questionnaires were designed using standards documents from the Genetics Society of America, undergraduate genetics textbooks, and current genetics research literature. Expert reviews were conducted to validate the questions. Student questionnaire responses were triangulated with interview data to elicit student misconceptions. Student responses and interviews were transcribed and coded via inductive methods. Each researcher independently coded student responses and then discussed elicited codes to establish inter-rater agreement. Preliminary findings have revealed nine misconceptions related to mutations and ten misconceptions related to pedigree analysis. The majority of misconceptions related to mutations include not understanding the role and function of the start codon and methionine, the differences between point and frameshift mutations, and assigning value and anthropomorphizing proteins and their functions. Several misconceptions related to pedigree analysis include misconceptions regarding the nature of the X chromosome compared to the Y chromosome, the independent nature of probability, and the misconstrued relationship of allele frequency to dominance.

Detecting Domain-Fronted Traffic using Neural Networks

Steven Sheffey, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

Domain fronting (DF) is a technique that subverts internet censorship by hiding network traffic in the encrypted portion of HTTPS connections to popular services. Because the traffic is encrypted, typical deep packet inspection techniques are not capable of identifying DF traffic. Past research (Wang et al.) used decision trees to identify DF traffic with a false positive rate (FPR) of 0.02%. In recent years, deep learning neural network techniques have been successfully used in a wide variety of classification tasks. We believe neural networks have the potential to achieve an even lower FPR and provide a foundation for future research that models the adversarial aspect of internet censorship. Thus, we propose a neural network to classify traffic as DF (positive) or HTTPS (negative) using data from a reproducible environment specifically built to capture HTTPS and DF traffic for this experiment. The neural network's efficacy is evaluated based on its FPR and accuracy. We hypothesize that our proposed neural network can identify DF traffic with a $FPR < 0.02\%$. By identifying features that differentiate DF traffic from HTTPS traffic, we hope to improve the privacy of DF users.

Electrochemical Detection of Acetaminophen with Silicon Nanowires

Raja R. Pandey, Graduate student, Chemistry; Hussain S. Alshahrani, Graduate student, Chemistry; Elissa Williams, Non-MTSU university faculty collaborator ; Sergiy Krylyuk, Non-MTSU university faculty collaborator, ; Albert V. Davydov, Non-MTSU university faculty collaborator; Charles C. Chusuei, Faculty, Chemistry; Charles Chusuei (Faculty sponsor) Chemistry

Acetaminophen (APAP) is known as an antipyretic, analgesic agent, the overdose of which during medical treatment poses a risk for liver failure. Therefore, it is necessary to develop methodology to analyze physiological APAP levels in order to avoid poisoning. Here, our group is able to report an effective, selective electrochemical APAP sensor prepared by depositing silicon nanowires (SiNWs) onto glassy carbon electrodes (GCEs). Electrocatalytic activity of the SiNW/GCE sensors was studied under various pH and concentrations of APAP using cyclic voltammetry (CV) and chronoamperometry (CA). CV of the SiNWs at 0.5 mM to 13 mM APAP concentrations was used to determine the oxidation and reduction potentials of APAP. Both oxidation and reduction of APAP at the SiNW/GCE surface is diffusion controlled, indicating faster diffusion for oxidation than reduction. The SiNWs demonstrated a clear increase in current with increase in APAP concentrations in the 0.01 to 3 mM range with excellent linearity within the 0.06 to 0.16 mM range in the CA analysis. The selective detection of APAP was then monitored using CA with potentially-interfering analytes at +0.568 V vs Ag/AgCl, where APAP is fully oxidized. The SiNW sensor has the ability to detect APAP well within the detection limit for APAP toxicity, showing promise as a practical biosensor.

The Subversive Masculinity of *Hey Arnold*, *Avatar: The Last Airbender* and *The Loud House*

Kristen Sales, Graduate student, Communication Studies and Organizational Communication;
Jane Marcellus (Faculty sponsor) Journalism

This research looks to analyze the way that subversive masculinity is represented in these animated series. This thesis looks at the way that the main male character, his best male friend and the main male antagonist is represented. This thesis will use three aspects to further analyze the subversive representation of masculinity. The first aspect is the difference between the male characters noted and hegemonic masculinity. Hegemonic masculinity, in this thesis, will define the common characteristics and behaviors attributed to male gender norms. The second aspect is the environment of the characters and the way that it affected the gender norms within the narrative. This will also bring forth a discussion on the gendered dynamic of these environments. The third aspect is the dynamic between the male characters and their female peers. This study will be beneficial for students, researchers that are invested in gender studies that focuses on masculinity and individuals that are interested in an academic study of these three series, especially given that these three series don't have a lot of academic research done on them. This thesis is in the proposal stage, with the majority of the needed academic research already completed.

Applied Ambisonics: Capturing Three-Dimensional Sound in a Live Setting

Adrienne Howard, Graduate student, Recording Industry; John Merchant (Faculty sponsor)
Recording Industry

Since the twentieth century, sound engineers have been aware of the need for spatial dimension to showcase their work, but due to the constraints of consumer applications, the need for a mainstream approach resulted in the use of conventional two-channel stereo limiting creative opportunities to reproduce spatial sound. The rise of Ambisonics, in combination with the development of the virtual and augmented reality, has triggered a shift in music production as well as the marketing expansion of the industry model. This project consists of two individual modules to explore the principles of Ambisonic sound. The research component of this project focuses on the concepts and practical application of Ambisonic recording, editing, and reproduction as compared to other surround systems. The creative element of this project consists of an A-B comparison of stereo microphone techniques as well as the encoding and decoding of Ambisonics recording, using the Soundfield SPS 200. My tests will explore the methods that Ambisonic recordings offer as compared to traditional two-channel stereo microphone techniques.

A Pilot Study: A Survey of Beginning Band Directors with Regard to Instrument Selection

Ke Ding, Graduate student, Music; Jamila Mcwhirter (Faculty sponsor) Music

The purpose of this study is to investigate the procedures beginning band directors may utilize in assisting students with instrument selection. This study focuses on the perceptions of band directors regarding musical experiences, students' physical characteristics and personality traits, and gender bias. A review of the related literature will be used to formulate the online survey, and a cover letter will be sent via email to the Middle Tennessee Band and Orchestra Association (MTSBOA).

Data collected through this survey will be reported as frequencies and percentages with categorization of comments to the open-ended questions. The results may indicate that (a) beginning band directors use multiple factors in helping students select instruments and (b) which factors beginning band directors believe are important when assisting students with instrument selection.

Recommendations that are provided may help guide band directors examine the manner in which instruments are most appropriately selected for beginning students. From these data, band directors may learn that matching students with appropriate instruments in beginning band is a factor in a student's desire to continue.

Workflow Scheduling and Optimization for Big Data Sciences in Distributed Network Environments

Huda Alrammah, Graduate student, Computational Science; Yi Gu (Faculty sponsor) Computer Science

Next-generation e-science is producing colossal amounts of data, termed as “Big Data”, on the order of terabyte, petabyte or even exabyte. These scientific applications typically feature data- and network-intensive workflows comprised of computing tasks with intricate dependencies, which need to be further analyzed and processed by geographically located users and scientists. Recently, an increasing number of scientific workflows has been moved to distributed cloud environments which provides on-demand access to a large pool of computing and storage resources over the Internet, and it calls for an efficient solution to schedule and optimize the performance of such applications. However, the large number of user requests and the limited resources pose a significant challenge on resource allocation, task scheduling, power consumption, latency, scalability, etc. The optimization problem of workflow scheduling on cloud environment is a complex task that must satisfy a variety of objectives and constraints while considering the heterogeneous of the underlying infrastructure. Therefore, we are interested in workflow scheduling and optimization problems with various objectives for scientific workflows in heterogeneous cloud environments. A lot of research efforts have been devoted to workflow scheduling but most of them are limited to two objectives. Other researchers have proposed meta-heuristic methods but they have a higher time complexity which makes them less useful in realistic environments. Moreover, most algorithms are static, making them unable to adapt to the cloud dynamism. We construct analytical cost models and consider important objectives in terms of makespan, monetary cost, reliability, and energy consumption for executing workflows on an appropriate set of computer resources. We develop algorithms based on both static and dynamic strategies, and we conduct extensive sets of experiments on both simulated and real scientific workflows.

An Adaptive Metropolis-Hastings Algorithm with Rejection-Based Gaussian Proposal Scaling for Fast Convergence in Multimodal Parameter Spaces

Graham West, Graduate student, Computational Science; John Wallin (Faculty sponsor)
Computational Science

One of the fundamental problems in mathematical modeling is that of dynamical parameter estimation. In order to model complex, nonlinear systems accurately, one needs to be able to determine the range of values of all key parameters involved. Thanks to the exponential rise in computing power over recent decades, this process can be done with ever-increasing speed and precision. However, beyond the use of faster processors, one can also develop more efficient algorithms to improve performance. In this poster, we present a modified Metropolis-Hastings algorithm which uses a Gaussian proposal distribution with adaptive scaling based on the number of recent consecutive sample rejections. The addition of this adaptive step allows the algorithm to converge to the optimal solution much more quickly than the standard algorithm when searching through parameter spaces having many local extrema. This is a valuable property when dealing with models which are computationally expensive to evaluate. Concerning results, we analyze the algorithm's performance in low-dimensional, multimodal parameter spaces as well as an application to the astrophysical problem of galaxy merger simulation.

Build Reliable Robotic Systems Through Model Checking

Yuxin Zhang, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

It is challenging to build a robotics system because of the system complexity and dynamic external environment. A model of the robotic system plays an important role in validating the design and providing guidance to the development of the system. Therefore, the correctness of the system model is essential for the successful development of the system. Currently, there are two major approaches that validate system models: theorem proving and model checking. In this presentation, we demonstrate an approach to facilitate the development of a robust robotic system. The proposed approach adopts model checking to verify and validate models of a soccer robotic player. The behavioral model of a robotic soccer player is constructed using Simple Promela Interpreter (SPIN), and the SPIN model checker tool is used to verify system properties written in Linear Temporal Logic (LTL). The approach can generate the framework of the robotic soccer player's implementation automatically. This proposed approach can enhance the confidence of the developed robotic systems and can be used to build competitive soccer robots like the Federation of International Robot-sport Association (FIRA)'s robot soccer tournaments.

Differences in the Male and Female Immune Response to *Cryptococcus neoformans* Infections

Tiffany Guess, Graduate student, Biology; Erin McClelland, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

Introduction: *Cryptococcus neoformans* is responsible for an estimated 220,000 cases of cryptococcosis, resulting in more than 181,000 deaths each year worldwide. Prevalence of this disease is skewed between males and females. Numerous studies show differences in *C. neoformans* infection rates, with males having a higher incidence of disease and death (7M:3F). Sexual dimorphism in infections is not uncommon. However, these differences in *C. neoformans* have not been well elucidated. Our goal is to unravel the complexity of sex-specific, host-pathogen interactions by examining the effect of sex on the immune response to *C. neoformans* and whether sex hormones contribute to those differences. We hypothesize that males have an increased incidence of disease due, at least in part, to differences in immune response during a *C. neoformans* infection. **Methods:** Peripheral blood mononuclear cells were isolated from 40 healthy volunteers and infected with *C. neoformans*. Physiological levels of testosterone and estrogen were added to subsets of all infections. Infected cells were incubated for seven days after which they were harvested and B- and T-cell responses assessed via flow cytometry. Analytes measured include: CD3, CD4, CD8 (T-cell markers), and CD19 (B-cell marker). **Results:** Data show lower numbers of all T-cell markers in males versus females during infection and lower numbers of B cells in infected males compared to uninfected males. There was no difference in hormonal treatment groups. **Discussion:** The sexual dimorphism seen in *C. neoformans* infections is commonly observed, but understanding what accounts for these differences is unknown. These results could aid in understanding why males have increased disease in *C. neoformans* infections.

Narrative of the Life of Alexander Hamilton, an American Immigrant: Hamilton as an Immigrant's Narrative of Ascent

Micah Hallman, Graduate student, English; Laura Dubek (Faculty sponsor) English

Frederick Douglass's *Narrative of the Life of Frederick Douglass* (1845) has become an integral part of the American literary canon. His slave narrative issues a call for other writers by using literacy as a way of moving through society and reclaiming one's history. The relationship between literacy and narratives of ascent also suggests that literacy is an integral part of reclaiming the power of historical narratives. Over a hundred years later, Lin-Manuel Miranda's musical *Hamilton* (2015) answers the call issued by Douglass's slave narrative by picking up the theme of literacy and using it to rewrite history. *Hamilton* rewrites what it means to be a part of the American experience. While retelling the story of America's beginning and founding fathers, Miranda focuses on the advances Alexander Hamilton made through society with his writing ability. This project will produce a literary analysis of *Hamilton* by examining specific scenes and quotes from major characters in the play and using secondary sources, such as commentary from Broadway reviewers, like Ben Brantley, Rebecca Mead, and Helen Lewis, to contextualize my analysis. By reframing Miranda's *Hamilton* as a narrative of ascent, my project will challenge what scholars consider American literature. People who are interested in this project will also be interested in narratives of ascent, Broadway plays, *Hamilton*, and historical narratives.

The Visual Album: Exploring the Creative Process from the Artist Perspective

Brian Seay, Graduate student, Recording Industry; Matt Foglia (Faculty sponsor) Recording Industry

This research examines the characteristics of a visual album by exploring the practical approaches to creating this hybrid art-form. To guide my study, I address three questions: 1.) what is a visual album, 2.) how is the visual album created, and 3.) what elements are comprised in creating a visual album.

With the visual album evolving in countless forms, from its origin of music videos promoting records to feature films and narratives, I briefly discuss this evolution by examining the history of its inception to modern day. By seeking to define the visual album in its myriad forms, I investigate Beyoncé's *Lemonade* (2016) to further my research on how this hybrid-art form unfolds into an artistic masterpiece.

The results of this research are to give consumers, fans, and pop culture a profound understanding and appreciation for this work of art. I applied my findings by creating a short film and music video to my leading single, "Obsessed." I co-wrote, produced, and recorded this pop/funk tune. My debut single will serve as a prequel to my visual EP (Extended Play of 5-6 songs accompanied with visuals) that will result in a commercially released body of work. In addition to this, I have assembled a production team of students and professionals through my newly established management company, Park Forest Entertainment. By acquiring this group, I have solidified my position in providing a high-quality visual product that will incorporate the various elements discovered throughout this research.

A Survey of Two Task-Scheduling Algorithms for Optimizing Efficiency on Cloud Computing Systems

Fred Nelson, Graduate student, Computer Science; Yi Gu (Faculty sponsor) Computer Science

As scientific computing tackles larger and larger problems, having cloud computing systems that are completing these workflows efficiently becomes an issue that grows with these problems. This project will explore two previously proposed approaches to solving these efficiency optimization problems. The first is a graph theoretical approach that finds energy-efficiency through a technique called Dynamic Voltage and Frequency Scaling (DVFS). One such example is the LEES algorithm. The second is a meta-heuristic evolutionary approach, meaning mimicking animal or insect behaviors to find an optimal solution, such as the echolocation behavior of bats. Our approach will be to compare and contrast these two approaches to optimizing for multiple objectives: energy-efficiency, data throughput, and choosing reliable machines in the cloud to complete tasks, and budget constraints. We predict that this research will contribute towards optimizing more than three objectives, and may also lead to the development of hybrid algorithms with similar aims.

Teaching String Intonation: Literature and Practice

Mahsa Marjorie Way-Kiani, Graduate student, Music; Jamila McWhirter (Faculty sponsor) Music

Beginning and developing string instrumentalists must be guided by teachers in order to cultivate an accurate sense of intonation as well as the ability to play in tune. Therefore, educators must promote accurate intonation to students just as they promote other vital musicianship skills like dynamics or articulations. The purpose of this content analysis is to examine the literature about teaching and improving intonation of string students. The content included in the analysis will comprise of articles, research studies, and method books. The analysis will focus on how method books address teaching string intonation and how this relates to published string intonation articles and research studies conducted with regard to string intonation. The guiding questions for the research will be: (1) How and to what extent do method books for strings address teaching intonation? (2) Do the method books provide practical suggestions for teachers that are corroborated by published string intonation articles and research studies? A review of the literature will provide the basis for and inform the content analysis.

Data will be reported using coding to categorize textual material, such as information and suggestions provided in the method books/articles/research studies. The results may indicate that: (1) Method books provide few/many practical suggestions for teaching string intonation (2) The method books' suggestions do/do not align with articles' and/or research studies' suggestions for teaching intonation.

Through a comprehensive analysis of literature on teaching string intonation, recommendations will be provided to guide string educators toward the most beneficial and practical ways to teach and develop string students' intonation.

Granger Causality Test and Cointegration of Interest Rate, Exchange Rate, and Stock Volatility at Chicago Options Market

Abul Hasnat Salimullah, Graduate student, Economics and Finance; Anthon Eff (Faculty sponsor)
Economics and Finance

This paper exploits the Granger causality test and the bi-variate as well as the multivariate cointegration to determine the interactions between interest rates, exchange rates, and the composite stock volatilities of different measurement of traded contracts under the Chicago Board Options and Exchange. Using the daily sector data for all observed variables from the St. Louis Fed over the period of 2007-2017 and introducing the method of simple vector autoregression, this study then examines various aspects of the correlation where the current and the previous values of volatility indices, interest rates, and exchange rates have shown significant Granger causality effects to the return behavior of those volatility indices, interest rates, and exchange rates. The estimated result makes it essential to understand how the stock volatility indices behave over the contemplated time, especially when the following changes in interest rate and exchange rate, which forecast one another. The result further indicates, under the absence of long-run relationships, interest rates have more unidirectional and bi-directional causal effects on the stock market volatility indices than in comparison with the exchange rates, although both of them are identified as major determinants of stock price volatility.

Piezoelectric Microphones: Creative Applications of Lo-Fi Transducers

Ana Cristina Ochoa, Graduate student, Recording Industry; Michael Fleming (Faculty sponsor)
Recording Industry

The Curie's discovery of the piezoelectric effect in 1880 allowed for the development of new transducer technologies that would become a staple in the recording industry between the 1930s and the 1960s. During this time period the marketplace remained saturated with piezoelectric microphones, but the introduction of low-cost dynamic and electret aeroacoustic microphones quickly proved to be a preferable alternative. After the introduction of these aeroacoustic microphones, the piezoelectric was phased out of microphone manufacture due to inherent deviations from the technical and sonic qualities of aeroacoustic transducers. A discussion of these qualities provides solutions for common user difficulties and reveals certain advantages in piezoelectric selection over aeroacoustic selection for both live and studio recording situations. Still an economical alternative to the traditional aeroacoustic microphone, music producers, recording engineers, and artists may elect to utilize a piezoelectric microphone to impart textures in their works, or may also attempt a more traditional recording approach. Both recording styles are presented in a collection of musical works recorded using solely commercially available piezoelectric microphones, in order to provide a prospective user with a sonic library from which to reference. In tandem with the sonic library, a user guide and generated specification sheet catalogue is presented, to aid a user with recording techniques and provide non-readily available technical data on commercially available piezoelectric transducers.

A Survey of Post-Secondary School Music Participation

Dakota Dooley, Graduate student, Music; Jamila McWhirter (Faculty sponsor) Music

Music educators strive to make music a lifelong activity for their students. Yet, there are large groups of students who decide to end their participation in music ensembles after high-school graduation, regardless of community and college ensemble offerings (Williams, 2007; Van Weelden & Walters, 2004). The purpose of this study is to collect data regarding the continuation or discontinuation of participation in music ensembles. The primary research question is "What are the reasons formally music-educated students either continue or cease to engage with their instrument/voice?". A review of related literature will be used to formulate the survey instrument. A confidentiality statement will be issued to each participant before the survey. Data will be collected from a large southeastern university and presented as frequencies and percentages. The results may indicate a connection between why some students choose to continue or discontinue their participation in music ensembles. This study may interest researchers or teachers concerned with students' participation or non-participation of formal music post-secondary school.

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Comment: Selected references should be Underline and bold.

References should be formatted in APA6th ed. format. - with "General Music Today, 17(2), 28-31.", and "Music Educators Journal, 94(1), 18-23." italicized. They should have hanging indents as well.

Molecular Basis of pH-dependent HIV gp120 Differences Revealed Using BESI

Scott Morton, Graduate student, Computational Science; Joshua Phillips, Faculty, Computer Science; Joshua Phillips (Faculty sponsor) Computer Science

Research in the field of HIV transmission has yet to provide a vaccine for the imponderable virus. Though progress has been made to extend the life of those chronically infected, a solution to the transmission of the disease outside of abstinence is still no where to be found. Previous laboratory studies involving electrostatic surface charge analysis revealed the sensitivity of gp120 to changes in pH across levels consistent with those found in the human body. A prototype computational approach was developed and found to agree with laboratory results. We previously refined the process and utilized additional methods to determine a system capable of classifying Env structures through machine learning techniques. We have expounded upon the analytical procedure to encompass the residue level and expanded the process to include minimization steps to ensure the integrity of the protein models. Additionally, the process has been enhanced with advanced data compression techniques to allow for more in depth analysis of the systems. In this research we continue to validate previous work in several studies as well as increase the returned knowledge through a new technique that reveals what we hypothesize to be the mechanistic residues responsible for the binding process.

A Benchmarking Study of NoSQL and SQL Databases

Nathaniel Boyer, Graduate student, Computer Science; Suk Jai Seo (Faculty sponsor) Computer Science

With the advent of "Big Data" it is essential to understand NoSQL (Not Only SQL) technologies to stay relevant. NoSQL databases are fundamentally different from Relational databases, which utilizes SQL (Structured Query Language) to query the server, as they do not follow the relational model which utilizes the ACID (Atomicity, Consistency, Isolation, Durability) properties. They instead use several different models and follow the CAP (Consistency, Availability, Partition) theorem. This makes it challenging to transition from one model to another. The goal of this research is to consolidate the work done by other researchers in one easy to find place, to implement several types of NoSQL databases for testing purposes and using that data to compare NoSQL and SQL databases. The results show that in some case NoSQL databases performed better than their traditional counterparts.

Recording Classical Guitar from Start to Finish: The Recording and Dissemination of a Classical Album in Today's Market

Garri George, Graduate student, Recording Industry; John Hill (Faculty sponsor) Recording Industry

This study examines first-hand the recording, promotion, and dissemination of a classical guitar record in a market where sales are continually declining. The album is a collection of solo and collaborative pieces by world-renowned composer and performer Excier Rodriguez. Instrumental combinations are explored, including solo and duo guitar and a concertino featuring guitar with a string section. Integrated into the recording process is promotional media to be posted online.

The primary focus of this study is the production and recording process. I explore each element involved, including the anatomy of the instrument itself, the philosophy of a classical recording, and preparing for and operating a recording session. I consult top experienced producers and engineers in the field and make aesthetic and technical decisions regarding appropriate venues and recording techniques for each piece. Information gathered from personal interviews and literary sources, as well as observations made from reference recordings, help to guide the process. Choices are also guided by the mood of each individual piece, the acoustic properties of the instruments, and practical considerations.

The final component of the study is the dissemination process. Alongside the musical recording is the creation of a video recording for promotional purposes. Upon completion of recording, editing, and mastering, the finished product is delivered to an aggregate that distributes to major music vendors.

The Role of Testosterone in the Melanization of *Cryptococcus neoformans*

Jamila Tucker, Graduate student, Biology; Erin McClelland (Faculty sponsor) Biology

Cryptococcus neoformans (*Cn*), a spore producing pathogenic yeast, is a fungal pathogen that affects immunocompromised individuals causing meningoenephalitis. Once *Cn* is introduced via the respiratory tract it is phagocytized by macrophages and other phagocytes. Multiple virulence factors cause *Cn* to be an immense threat to humans; particularly its ability to produce an abundant amount of melanin. Melanin is a pigment that protects the yeast against UV radiation and oxidizing agents. During phagocytosis, a macrophage utilizes respiratory bursts to kill pathogens. Since *Cn* uses melanin to effectively defend against these oxidizing agents to survive phagocytosis, it is one of its main virulence factors. Melanin is produced via two pathways in fungi: the DHN pathway and the L-3,4-dihydroxyphenylalanine (L-dopa) pathway. *C. neoformans* develops melanin only via the L-dopa pathway. Recent studies suggest a difference between the melanization of *Cn* cells in the presence of exogenous testosterone and estrogen, where *Cn* in the presence of L-dopa with testosterone melanizes at a faster rate compared to *Cn* in the presence of L-dopa with estrogen. We hypothesized that this variation could be due to *Cn* cells utilizing testosterone as a substrate to produce melanin. However, this hypothesis was found to be incorrect. We now hypothesize that the difference in melanin production in the presence of testosterone may be controlled at the RNA level or through a quorum sensing pathway. Data from qRT-PCR experiments show that differences in gene expression exist between treatments, suggesting this hypothesis may be correct. RNA sequencing is currently underway to determine what specific genes are induced in the presence of testosterone. This data will help elucidate the currently unknown molecular processes of melanization in *Cn* and how steroid hormones affect them.

How to Design, Produce, and Disseminate an Effective Online Pro Audio Educational Series

Kyle Holland, Graduate student, Recording Industry; Cosette Collier (Faculty sponsor) Recording Industry

The world of the 21st century has quickly become entrenched in the digital age. Companies, designers and consumers alike have quickly embraced computers and the Internet as modes for production and communication due to the increased efficiency and accessibility they provide. The music, audio, and educational industries have had no hesitation in adopting such technologies. In recent years we've seen the prevalence and subsequent rise in popularity of websites, forums, blogs, ebooks, and social media channels devoted to the dissemination of audio knowledge, with the mission of educating new engineers, producers, and musicians, all over the world.

The goal of this project is to research, analyze, and form conclusions regarding subjects such as course design, topic selection, dissemination mediums, marketing methods and anything else relevant to creating and disseminating an effective, and enjoyable pro audio tutorial/ educational series. Research will be conducted through a variety of methods including, but not limited to surveys, interviews, focus groups, website analysis, and other academic and pedagogical publications regarding online learning.

The information and conclusions formed from the research will then be implemented in the creation of a new web based pro audio video tutorial series, as well as any other applicable supplementary materials, such as social media pages, eBooks, and downloadable multitracks.

Encoding and Generating Musical Patterns with Markov Chains

Joseph Volmer, Graduate student, Computer Science; Suk Jai Seo (Faculty sponsor) Computer Science

An important part of the creative process is inspiration. In order to find inspiration, it is often helpful to reach to creative tools that can aid in developing new ideas. Aleatoric composition techniques involving random decisions can be inspirational to an artist. Currently demonstrated research generating musical patterns with statistical models is not easily accessible to someone with no technical knowledge. We discuss a web application interface using sockets, and Markov chains trained on MIDI messages that demonstrate such an interaction. This interface can help bridge the gap between musicians and Machine learning. In order to validate the results, we conduct a small survey online with a test group of electronic musicians on metrics such as ease of use, musicality and listenability of the results.

A Human-Following Robot for Household Fall Detection

Simeon Adebola, Graduate student, Engineering Technology; Lei Miao (Faculty sponsor)
Engineering Technology

In homes of elderly members of the population living alone, a fall without help being quickly provided can prove fatal. Thus, there is a need for constant yet privacy-conscious monitoring of their state and being. We propose to do this is by having a robot with an onboard microprocessor unit to detect, track and so follow them around the house. If there is a fall, the robot will detect it and appropriate help can be gotten as soon as possible. In this abstract, we present the first part of this project with the use of the Pi Noir Camera Module V2, a low-cost infrared camera, to be mounted on the robot and serve as its control sensor, which can be used to detect and track human faces irrespective of the lighting condition. The project will simulate falls by detecting sudden changes in face, location, height, and motion. It will also enable interactive capabilities to address false positive signals. Both the OpenCV and Picamera Python libraries are used for face detection, recognition and tracking.

Key Words: Robot, Computer Vision, Human Detection, Human Tracking, Fall Detection

Hellcats, Bitches and Succubi: Afro-Futurism and Black Female Selfhood in *Lilith's Brood*

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Although Black women are the most underrepresented group within modern literature, they emerge as giants within the genre of Afro-Futurism. Afro-Futurism presents the Black female artist with an opportunity to “dream a world” and thereby speak and place herself squarely at the center. Octavia Butler’s trilogy *Lilith's Brood* is a generational exploration of character that allows readers to experience a Black female character fully developed and fully actualized. Using Kokavah Zauditu-Selassie’s African ontological approach, I will explore how Lilith represents the self as mind, as body and as pure power. I will contextualize my reading of Butler’s work within relevant literary criticism and theory such as Julia Hoydis’ “Fanastically Hybrid: Race, Gender and Genre in Black Female Speculative Fiction,” Kokavah Zauditu-Selassie’s “Step and Fetch It” and “A Knowing So Deep,” Christina Sharpe’s “In the Wake, On Blackness and Being,” and “Octavia’s Hidden Power” by Nnedi Okorafor. My project will speak to the current fascination with Afro-Futurism illustrated by the critical acclaim and box office success of Marvel’s Afro-Futuristic film *Black Panther*.

Linearly Implicit Predictor-corrector Schemes for Space Fractional Reaction Diffusion Equations

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Linearly implicit predictor-corrector methods are proposed for solving space-fractional reaction-diffusion equations with non-smooth initial data. The methods are based on Matrix Transfer Technique for spatial discretization and are shown to be unconditionally stable. It is observed that the linearly implicit predictor-corrector method derived by using (1,1)-Padé approximation to matrix exponential function incurs oscillatory behavior for some time steps. These oscillations are due to high frequency components present in the solution and are diminished as the order of the space-fractional derivative decreases (slow diffusion). We present a priori reliability constraint to avoid these unwanted oscillations and generalize the constraints for all (m,m) -Padé approximants, $m \in \mathbb{Z}^+$, to the matrix exponential functions. These time stepping constraints are seen to be dependent on the order of the space-fractional derivative. The linearly implicit predictor-corrector method based on the (0,2)-Padé approximations to the matrix exponential function is shown to be oscillation-free for any time step. Error estimates are obtained for the methods and are theoretically shown to be second-order convergent. Computational complexity of the algorithms is discussed for solving multidimensional space-fractional reaction-diffusion systems. Several numerical experiments are performed to support our theoretical observations and to show the effectiveness, reliability, and efficiency of the methods.

Modeling Cybersecurity Threats Using GPU Computing

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Information Technology management is challenged to invest in technology effectively to balance the needs of the organization and cost. Security is viewed as one of the most critical areas of the infrastructure as breaches can result in a financial loss as well as the loss of sensitive information. In Baldwin, *et. al.* (2017), the authors present a novel approach to modeling cybersecurity attacks on network ports using a system of stochastic differential equations with jumps exhibiting self-excitation through a Hawkes process. In addition, this model demonstrates the existence of a contagious relationship between attacks on different network services. Threat data is taken from the Internet Storm Center's database (<http://dshield.org/>) which is collected from participating organizations. We extend the research from Baldwin, *et. al.* (2017) to a cloud-based high-performance computing (HPC) framework utilizing a cluster of servers equipped with graphics processing units (GPU's). Rather than simulating the SDE's with Monte Carlo, we implement the simulation using antithetic multilevel Monte Carlo to further improve the performance of the simulation. These enhancements provide a mechanism for near real-time modeling and analysis of Internet security threats.

Modification of Multi-Walled Carbon Nanotubes with Cobalt Oxide Nanoparticles for Dopamine Sensing

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Dopamine (DA) is an important neurotransmitter that plays a role in pleasure and motivation. A composite consisting of cobalt oxide nanoparticles and carboxylic-acid-functionalized multi-walled carbon nanotubes (cobalt oxide/MWCNT-COOHs) was fabricated for the biochemical detection of DA. Cobalt oxide was tethered to MWCNT-COOHs using sonication. The glassy carbon electrode was modified with this nanocomposite. Current versus concentration was measured using cyclic voltammetry. Different parameters such as loading, pH and sonication times were varied for the best current response. At pH 5, the current response was found to be highest, and the best sonication time was identified to be 30 minutes. Good selectivity was found against acetaminophen, uric acid, folic acid and ascorbic acid.

Cobalt Complexes of Tripodal Phosphorus/Nitrogen Mixed Donor Ligands: Applications for Catalytic Dehydrogenative Coupling Reactions

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Abstract: Environmentally benign (“green”) synthetic methodology is an enchanting approach for acceptorless dehydrogenation reactions, that cutoff the use of stoichiometric amounts of inorganic oxidants as well as cease the generation of copious stoichiometric, often toxic waste. Acceptorless dehydrogenation reactions are appealing because hydrogen and water are the sole by-products during catalytic scission of C-H, N-H, and/or O-H bonds. Catalysis by base metal complex is the recent development in the field of acceptorless dehydrogenation reactions which release and consume hydrogen gas in situ. To the best of our knowledge, it is the first time that base transition metal complexes stabilized with a class of tripodal ligands featured with mixed P, N donors is used for synthesis of esters, ketones, imines and secondary amines. Our purpose is not only liberate hydrogen as a by-product but also replace precious metal catalysts by earth-abundant and less toxic metals. These air and moisture stable complexes serve as great pre-catalysts for dehydrogenation and dehydrogenative coupling reactions.

Multi-Cultural Music Experiences of Collegiate Music Majors

Shan Zheng, Graduate student, Music; Jamila McWhirter (Faculty sponsor) Music

The purpose of this study is to investigate the perceptions multi-cultural music experiences of collegiate music majors from a History of Western Art music class. The definition of multi-cultural music, for the purposes of this study, is the music from cultures other than the Western European culture.

Data collected will be reported as frequencies and percentages. A ten-question survey will be developed from the review of literature and distributed to music majors in a History of Western Art music class. The results may indicate that music majors (a) have numerous interactions with multi-cultural music and (b) have a deeper understanding of multi-cultural music experiences due to the diversity of opportunities and experiences that being a music major affords.

Recommendations provided can help guide collegiate music departments in examination of the teaching of multi-cultural music and the variety of offerings, as well as bring awareness to music majors regarding the opportunities offered for multi-cultural experiences on their campus.

Title: Surface Chemistry and Spectroscopy Study of α -Synuclein and the NAC Part

Sunday Olaluwoye, Graduate student, Chemistry; Chengshan Wang, Faculty, Chemistry;
Chengshan Wang (Faculty sponsor) Chemistry

Parkinson's disease is the second most common neurodegenerative disease and is characterized by a progressive loss of the dopaminergic neurons in the *substantia nigra*. The degenerating dopaminergic neurons develop a hallmark deposition of Lewy bodies comprising abundant abnormal aggregates (*i.e.*, fibrils) of α -synuclein (α -syn), which is a protein contains 140 amino acid residues. Despite the abundance ($\sim 1\%$ among the total proteins) in the brain, α -syn accumulates in the presynaptic terminals where exists high concentration of amphiphilic structure (e.g., liposomes and cell membrane) and the reason of the accumulation of α -syn in the presynaptic terminals was not clear. On the other hand, The primary structure of α -syn constitutes three domains: N-terminal residues 1–60; the nonamyloid component (NAC) which spans residues 61–95 and has been reported to be prone to aggregation; and residues 96–140 which comprise the negatively charged C-terminus. Here, both α -syn and its NAC part (*i.e.*, α -syn(61-95)) were synthesized and purified. α -Syn and α -syn(61-95) were shown to be able to form a stable Langmuir monolayer by Langmuir technique, which utilizes air-water interface to mimic the amphiphilic structure *in vivo*. From circular dichroism and FTIR results, both α -syn and α -syn(61-95) transform from unstructured conformation in aqueous solution to α -helix at the interface. Because α -helix is stable at the interface, this transformation explains the reason of the accumulation of α -syn around the amphiphilic structure. α -Syn(61-95), the NAC part of α -syn, did not aggregate at the interface. This also suggests the amphiphilic structure stabilizes α -syn and inhibits its aggregation. The onset of Parkinson's disease may be due to the loss of amphiphilic structure (such as phospholipids) in aging people.

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Laser Applications to Enhance Combat Efficiency

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Engineering Technology

This paper identifies the growing rate of laser technology and their applications within the military. As opposing forces find new and creative ways to create destructive damage with everyday house hold items, new and readily available technology needs to be equipped to combat those forces. The military holds the lives of its soldiers to the highest esteem, but there is a limit on how much money can be allocated to individual soldiers. Newly administered laser applications have been created ideally to protect the lives of soldiers on the battlefield and greatly enhance the combat force. Within this paper laser applications of the past and present will be dissected into sections and compared and contrasted in order to determine the most effective path for future applications. Lasers will be able to reduce the required military force needed for defensive fortifications of operating bases along with fortifying the perimeters of the United States.

Prioritizing Test Cases for Regression Testing

Vishwa Patel, Graduate student, Computer Science; Suk Seo (Faculty sponsor) Computer Science

Software engineering requires a significant amount of software testing. The software goes through many changes as the software evolves. Regression testing is a kind of software testing that ensures that previously developed and tested software still perform in the same way after the software has changed. Regression testing is a significant component in the maintenance phase where the software system may be corrected or enhanced to improve its performance. Whenever software is modified, a set of test cases are run to assure that changes do not affect the other parts of the software. Running all these test cases requires effort and time, which makes regression testing expensive. Test case prioritization (TCP) can solve this problem by ordering test case in an attempt to ensure that the high priority test cases are executed first to uncover maximum faults. Test case prioritization aims to increase the rate of fault detection, reduce cost, and decrease the time needed to test the software. Previous research has shown several techniques which can improve the rate of fault detection. However, to obtain an optimal order, the requirement analysis should be done before ordering the test suite. This paper reports the results from the best-proposed algorithm or a combination of algorithms, which can increase the efficiency of fault detection at an early stage. Thus, TCP improves the reliability of the system and the precision of the software.

Temporal Integration of Mitochondrial Stress Signals by the PINK1:Parkin Pathway

Mary Catherine Skolfield, Graduate student, Biology; Wesley Riley, Graduate student, Biology; Logan Bowling, Graduate student, Biology; David Nelson, Faculty, Biology; David Nelson (Faculty sponsor) Biology

The PINK1:Parkin pathway is an essential mitochondrial ‘quality-control’ mechanism in mammalian cells, which is capable of identifying and initiating the autophagic destruction of damaged and dysfunctional mitochondria. The pathway detects a loss of mitochondrial membrane potential (MMP) – the proton gradient established across the inner membrane of actively respiring mitochondria – at damaged mitochondria and catalyzes the conjugation of phospho-polyubiquitin chains to outer mitochondrial membrane proteins. This triggers the recruitment of autophagic adaptors to the membrane and the eventual destruction of the affected mitochondria. The response of this pathway to complete and continuous loss of MMP has been well documented but the way in which the pathway interprets and responds to more complex inputs, such as partial depolarization or repeated depolarization events, has yet to be determined. To investigate this, we exposed cells to brief 30-minute pulses of the protonophore CCCP, which causes reversible loss of MMP and observed that PINK1 exhibited cycles of mitochondrial association and rapid dissociation as CCCP was added and removed. However, Parkin, a protein recruited by PINK1, remained associated with the mitochondrial membrane long after CCCP removal, with its levels increasing after each CCCP treatment due to its association with phospho-polyubiquitin chains that were assembled on the outer mitochondrial membrane by PINK1 and Parkin. In this way, the PINK1:Parkin pathway is capable of integrating information about mitochondrial activity over time and this is encoded at the level of phospho-polyubiquitin chain assembly and Parkin accumulation. These data provide new insights into how the pathway may respond *in vivo*, in aging cells when mitochondrial activity begins to diminish and may be particularly important for our understanding of neurodegenerative diseases that have been linked to dysfunction of the PINK1:Parkin pathway.