

## Nickel Catalyzed Decarbonylation of Aromatic Aldehydes

Keying Ding, Faculty, Chemistry

We report here the first systematic study of nickel catalyzed decarbonylation of aromatic aldehydes under relatively mild conditions. Aldehydes with electron donating groups at *para* and *ortho* positions are generally successful with our method. For aldehydes with electron withdrawing groups, significantly higher yields were achieved for *ortho* substituted substrates than *para* ones, probably due to the effects of steric hindrance or electron donors at the *ortho* position to suppress the Tishchenko reaction, an undesirable side reaction towards homo-coupled esters.

## The Stones River Fault Zone, Central Tennessee: Reactivation of a Graben-Bounding Fault

Mark Abolins, Faculty, Geosciences

By overlaying published geological data on published geophysical data, the investigator shows that the Stones River fault zone likely coincides with the western edge of a subsurface graben. The Stones River fault zone is an inferred east-side-down subsurface structure located in central Tennessee. The fault zone strikes approx. 356 deg., contains at least one minor fault and numerous fault-parallel joints, is approx. 25 km long, and is associated with structural relief of approx. 40 m. Fault characteristics are based primarily on the orientation, length, and amplitude of the Stones River syncline, a macroscale fold mapped at the surface and interpreted as a fault-propagation fold. In addition, the fault interpretation is consistent with the depth of basement within a pair of boreholes that straddle the zone.

A published density model based on gravity and seismic wave velocity data shows that the Stones River fault zone coincides with the western edge of a north-trending segment of a belt of higher density upper crust. As a whole, the belt trends north-northeast and cuts across the entire state of Tennessee. The belt is more than 25 km wide in places, and, within much of the belt, the density of the upper 5 km of the crust is inferred to be more than 25 kg per cubic meter higher than in adjoining areas. The investigator interprets this belt as a basement graben containing sedimentary and mafic igneous rocks.

The timing of graben formation and fault reactivation are not tightly constrained. However, some grabens in Kentucky and Alabama formed during the Cambrian, and other cratonic grabens formed during the Precambrian. The most recent movement within the Stones River fault zone post-dates deposition of folded Ordovician strata, and movement may have coincided with the late Paleozoic reactivation of many Precambrian and Cambrian faults within the region.

### Modules for Teaching Statistics with Pedagogies using Active Learning (MTStatPAL)

Lisa Green, Faculty, Mathematics; Nancy McCormick, Faculty, Mathematics; Scott McDaniel, Faculty, University Studies; Ginger Rowell, Faculty, Mathematics; Jeremy Strayer, Faculty, Mathematics

The American Statistical Association endorses the Guidelines for Assessment and Instruction in Statistics Education recommendations, which include using active learning to teach concepts in introductory statistics effectively. With support from a National Science Foundation Transforming Undergraduate Education in STEM Grant and prior support from an MTSU Instructional Technologies Development Grant, MTSU faculty developed a Modules for Teaching Statistics with Pedagogies using Active Learning (MTStatPAL) Workbook and corresponding out-of-class videos with embedded quizzes to help instructors effectively use active learning to teach important concepts in introductory statistics. The corresponding instructor materials include the traditional ancillary materials such as student handouts, objectives, directions, and a solutions guide. Moreover, instructors are also provided with an example script for use during the in-class activity and a video of an experienced professor completing the activity with a class.

The MTStatPAL project team researched how the elements of the introductory statistics learning ecology (tasks students solve, kinds of classroom discourse, norms of participation, tools used for learning, and the practical ways the teacher orchestrates relations between these elements) are impacted by the implementation of the MTStatPAL modules. Data were collected using student surveys, teacher interviews, and pre- and post-tests. This poster provides the results from the successful course redesign to transition MTSU's MATH 1530/1530K, Applied Statistics, course from being lecture-based to a student engaged approach. These materials were also tested at a two-year institution, and it was found that the materials are appropriate for this audience as well.

### Roles of Proof: Activities That Are Lasting

Sarah Bleiler-Baxter, Faculty, Mathematics and Science Education; Jeffrey Pair, Graduate student, Mathematics and Science Education

In order for students to learn proof in a meaningful way, several roles of proof must be considered, such as verification, explanation, systematization, discovery, and communication (De Villiers, 1990). Students may find proof to be more meaningful if they know, understand, and experience the various functionalities of proof utilized by mathematicians in authentic disciplinary work. More research is needed to understand how the various roles of proof can be incorporated into mathematics instruction (Knuth, 2002; Hemmi, 2010).

In this study, we consider student perceptions of their engagement in the five roles of proof at the end of an inquiry-based learning (IBL) proofs course, seeking insight into the activities/events of the course that were lasting, or most memorable, to students with respect to engaging in the five roles of proof. Through investigating student perceptions, we gain a sense of the residue of the course from the student perspective.

We investigated 65 written reflections on an end-of-semester assignment from 13 undergraduates in an IBL transition-to-proof course. Students reflected on activities distinctive of the inquiry-based environment (such as discussing, presenting, conjecturing, and critiquing) as influential to their engagement in the roles of proof. For example, student-generated conjectures fostered an environment where the validity of the conjectures was truly in question, and students saw the need for proof as a means to convince (i.e., the verification role). Moreover, students recalled discussing as influential to their engagement in the explanation role of proof, and presenting and critiquing activities as influential to their engagement in the communication role. We provide student quotations highlighting our findings and offer implications for research/practice.

## VFR Course Planning with Paper Charts versus Electronic Charts

Tyler Babb, Faculty, Aerospace

Pilots are now training with electronic flight bags (EFBs) which essentially replace their former paper navigation charts. There are several types of aviation software available. This research identified potential gaps in pilot knowledge when planning a VFR flight with software versus planning it with conventional tools and methods. The research identified a reduction in 90% of skills and/or knowledge required when flight planning with a common software.

This paper was published in the International Journal of Aviation Science in December of 2016.

Professional Pilot Commercial Off-the-Shelf (COTS) EFB Usage, Policies, and Reliability

Tyler Babb, Faculty, Aerospace

Pilots are now using tablets such as iPads for flight-related information. This project surveyed more than 230 pilots from 80 different flight operations within the U.S. to find out how they comply with FAA regulatory requirements related to electronic flight bags (EFBs). The research also identified reliability discrepancies among common hardware/software combinations.

## Using Optimal Control Theory to Identify Network Dynamics that Foster Synchrony

Rachel Leander, Faculty, Mathematics; Suzanne Lenhart, Non-MTSU university faculty collaborator, Mathematics; Vladimir Protopopescu, Government agency collaborator, Computational Science

The Kuramoto model describes the synchronization of a heterogeneous population of oscillators through a stationary and homogeneous network in which oscillators are coupled via their phase differences. It is used to model both physical and neurological systems.

Recently, there has been interest in studying synchronization on time-varying networks, and time-varying generalizations of the Kuramoto network, in particular. Previous results indicate that networks with fast dynamics may be as efficient as static networks at promoting synchrony. In this presentation we use optimal control theory to study synchronization on a time-varying Kuramoto network. Our results indicate that time-varying networks can be more efficient than static networks at promoting synchrony and show that fast network dynamics are not necessary for efficiency. In particular, we show that near the synchronization threshold, time-varying networks can promote synchrony through slow oscillations that lengthen the duration of high synchrony states and shorten the duration of low synchrony states. Interestingly, repulsion is an essential feature of these optimal time-varying networks.

## Characterization of Tilapia Skeletal and Cardiac Muscle Transcriptome and Identification of Muscle Degeneration Genes

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

Tilapia is the second most cultivated fish in the world and the US is the largest importer of tilapia fillets. In Asia and Africa, tilapia culture provides dietary sources of protein for millions of poor families, and it is an important means of economic development. A major constraint to increasing production efficiency is the lack of genetically improved strains of fish for aquaculture. To enable the aquaculture industry, we need to define genetic parameters that control inheritance of complex traits such as muscle growth.

Muscle growth is limited by genes that cause muscle degradation. In tilapia, little is known about the muscle transcriptome and genes that cause muscle degradation. In this study, publically available transcriptomic data, 53,932,876 and 57,773,308 reads for muscle and heart were assembled using Trinity software. The assembly yielded 54,353 and 75,824 non-redundant sequence contigs. These contigs were annotated by KEGG mapping that resulted in 8001 and 9627 annotated sequences for muscle and heart, respectively. The numbers of annotated sequences for environmental information processing were 2665, 3152, which included 105 and 116 foxo-signaling genes. In addition, there were 1470 and 1561 sequences belonging to genetic information processing, including the ubiquitin mediated proteolysis pathway (133, 137 transcripts) and the proteasome pathway (47, 49 transcripts). Activation of these pathways leads to increase in muscle atrophy. In this study, we characterized two muscle atrophy-causing gene families: 1) the Murf1, Murf2, Murf3 genes, with 432, 372 and 365 amino acids, respectively, and 53-97% amino acid sequence identity with homologous genes in other fish. 2) Atrogin FBX025 and FBX032 genes, with 355 and 358 amino acids, respectively, and 75-99% amino acid identity with homologous genes in other fish. Currently we are measuring variations in expression of these genes in response to starvation-induced muscle wastage.



Middle Tennessee State University ADVANCE: Spotlight on Changing the Institutional Culture to Improve the Recruitment, Retention, and Advancement of Women STEM Faculty

Judith Iriarte-Gross, Faculty, Chemistry; Brad Bartel, Faculty, Sociology and Anthropology; Wandi Ding, Faculty, Mathematics; Jackie Eller, Faculty, Sociology and Anthropology; Karen Petersen, Faculty, Political Science; Michael Hein, Faculty, Psychology; Gretchen Webber, Faculty, Sociology and Anthropology

Over the past 15 years, MTSU has been effectively shifting our focus from a Master's Large University to a Doctoral Research University. This repositioning has resulted in new Ph.D. programs, increased research responsibilities for faculty, and more focus on best practices for the recruitment, retention and promotion of faculty. The MTSU ADVANCE (HRD-1409638) grant provided us the opportunity to analyze the experiences of women STEM faculty with the goal of promoting gender equity. Like many universities, men STEM faculty outrank women, and our hires in STEM are more likely to be men. Our Campus Climate survey and focus groups identified several areas that indicate perceptions of gender disparities. In our survey we find statistically significant differences between the perceptions of women and men about evaluation processes, resource allocation, campus climate, and work-life balance. We also see gender differences in reasons for leaving MTSU, in assessment of salary and workload, in perception of fairness and in concerns about consistency and clarity of tenure and promotion processes. We will present specific findings from the climate survey and focus groups along with recommendations for policy change.

### The Effects of Coloring on Stress Reduction

Montana Word, High school student, Psychology; Gene Cowart, Central Magnet School, and Tom Brinthaupt, Psychology (Faculty sponsors)

The purpose of this study was to determine the effects of coloring on stress decreation. Twelve students from Central Magnet School were used in the study and were arranged into the following three groups: Control Group, Experimental Group A, and Experimental Group B. Participants in the Control Group only colored. Participants in Group A colored after engaging in a stressful activity. Participants in Group B colored before the stressful activity. It was predicted that coloring after the stressful activity would have higher stress reduction than coloring beforehand. The participants who completed the puzzle had lower stress levels than the other two groups. When comparing Experimental Group A to Experimental Group B, Group B ended up showing a greater stress reduction than Group A, which does not support the current hypothesis. In conclusion, the data and results collected are not significant enough to make any real conclusions and more testing is needed to be done in the future.

### Are Sight-Readers More In-Tune with Visuospatial Ability?

Sarah Jones, High school student, Psychology; Gene Cowart, Central Magnet School, and Cyrille Magne, Psychology (Faculty sponsors)

The positive influence of music on many areas of cognition has been documented through previous research, but there are many aspects that have heretofore been relatively unexplored or of which results have been disputed. This study focused on the relationship between visuospatial ability and music experience: more specifically music sight-reading ability, a distinction which many previous studies have not made. Visuospatial ability is important to many varied disciplines, and all would find this study relevant. Educators, especially those of music students, would benefit most from the findings of this study. The experiment tested students enrolled in a local high school, separating participants into groups of non-musicians, musicians who cannot sight-read, and sight-reading musicians. Participants took timed, multiple-choice visuospatial tests that assessed their abilities to conceptualize changes in perspectives and orientations. By conducting experiments in multiple visuospatial domains using the same participants, the current study attempted to provide an explanation for the different results obtained in former studies. This experiment looked at whether musicians proficient in sight-reading performed better on visuospatial tests, due to abilities like vertical discrimination that are required for reading musical notation but are not nearly as prevalent in most written language.

### The Treatment of Emotional Abuse Using Bibliotherapy

Emily Mullins, High school student, Psychology; Sophie Falcofsky, High school student, Psychology; Gene Cowart, Central Magnet School, and Tom Brinthaupt, Psychology (Faculty sponsors)

Past research concludes that experiencing emotional abuse as a child has many adverse effects on the child's health later on in life. Emotional abuse is difficult to detect because physical signs of abuse are not typically present. Many studies attempt to define emotional abuse and examine traditional methods of treatment for children who have been emotionally abused. The present study investigates bibliotherapy as an effective way to treat emotional abuse in children. Many forms of treatment occur outside of the school environment: implementing a way to treat emotional abuse while children are still in the school environment will be immensely helpful to children. The current study includes data collected from a survey sent to guidance counselors from Rutherford County Schools. Data collected through the current study supports the idea that guidance counselors are being trained on abuse consistently and effectively. Therefore, the current study concludes that both teachers and guidance counselors will benefit from being trained on how to use bibliotherapy within a school environment.

## The Effects of Multitasking on Filtering Out Information in the Brain

Zoe Trageser, High school student, Psychology; Gene Cowart, Central Magnet School, and Tom Brinthaup, Psychology (Faculty sponsors)

This experiment was designed in order to determine what types of tasks people tend to filter out when multitasking. The MATB-II program, a computer simulation designed by NASA, was utilized in order to test the participants' multitasking ability. The MATB-II simulation featured four tasks (monitoring, communication, resource management, and tracking) that participants had to attempt to complete simultaneously. The participants' scores were then analyzed to determine which tasks they performed (in comparison to each other) better on. Specifically, the data from the communication task and the different parts of the monitoring task were analyzed in depth for each participant. The data disproved the original hypothesis that participants would filter out the communication task the most, and therefore receive the lowest score on this portion. Participants on average actually received lower scores on the different portions of the monitoring task, supporting the idea that participants responded to communication tasks more accurately when asked to multitask.

### Elementary Special Education: Curriculum and Integration Ideals

Samantha White, High school student, Psychology; Gene Cowart, Central Magnet School, and Tom Brinthaupt, Psychology (Faculty sponsors)

This study synthesized previous research with the results of a survey sent to elementary special needs teachers in an attempt to devise the perfect special education program, especially in regards to integration and curriculum, because current programs are not sufficient. The research suggested that special needs education has to be very diverse in its methods just like the students in the programs. It was hypothesized that changes in both curriculum and integration would be necessary. The survey consisted of thirteen open-ended questions and three questions that were rated on a Likert scale and was emailed to nineteen special education teachers from Rutherford County Schools. The main purpose of the survey was to see what the teachers had to say about integration and curriculum. Eight responses were received, and the recurring topic in the responses was a need for individualization in every aspect of elementary special education. It was concluded that the generic, perfect special education program is impossible to create.

### The Effects of High School Culture on the Mental Health of Gifted Students

Chase Burton, High school student, Psychology; Gene Cowart, Central Magnet School, and Tom Brinthaup, Psychology (Faculty sponsors)

Students in high school are increasingly feeling more stress, anxious, and depressed due to their personal and school lives. This study examines the effects high school culture has on stress, anxiety, and depression in gifted students. Students from a magnet school completed a survey asking them to rate the severity and occurrence of their stress, anxiety, and depression, along with choosing from a selection of stress triggers and relievers that are most stressful and stress relieving to them. It was hypothesized that older students would report experiencing each of the three issues more severely than younger students. It was also hypothesized that students reporting severe stress would select similar stress triggers. The findings of this study suggest that younger students did experience more severe stress and anxiety, but older students experienced more severe depression. Students that reported having severe stress tended to select similar stress triggers

## Development of Live Cell Reporters of Macrophage Polarization

Devyn Hayes, Undergraduate student, Biology; David Nelson (Faculty sponsor) Biology

**Background:** Macrophages are phagocytes of the innate immune system and act as the first line of defense against infection by 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 that is accompanied 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. Macrophages can also be alternatively activated (M2), which decreases antimicrobial activity and enables macrophages to participate in tissue repair. However, certain pathogens can interfere with macrophage activation, promoting M2 rather than M1 activation, enabling them to avoid destruction.

**Methods:** To investigate whether the pathogen yeast, *Cryptococcus neoformans* (*Cn*) affects macrophage activation we have developed a fluorescent live cell reporter to monitor *Nos2* expression. The reporter is stably transduced in cultured RAW264.7 murine macrophage cells using a lentiviral vector encoding a red mCherry fluorescent protein under the control of the *Nos2* gene promoter. To test the reporter, we exposed the cells to bacterial lipopolysaccharide, which induces M1 polarization, and measured changes in mCherry fluorescence by live cell microscopy.

**Results:** Our preliminary experiments suggest that the reporter is working correctly, with mCherry expression showing similar kinetics to the endogenous *Nos2* gene.

**Conclusions:** Our reporter shows great promise in imaging M1 activation. We intend to modify our system to incorporate an additional M2 reporter, enabling us to capture a more complete picture of how *Cn* affects macrophage polarization. We also envisage that the completed M1:M2 reporter cell line could be used as a powerful tool to both investigate the effects of other pathogens on macrophage polarization and as a drug discovery tool that could be used for the discovery of novel anti-inflammatory agents.



## School to Prison Pipeline: Applying the Critical Race Theory and Restorative Justice Model

Kendra Cheek, Undergraduate student, Social Work; Justin Bucchio (Faculty sponsor) Social Work

The school to prison pipeline, defined as punishing students for minor offenses and referring them to law enforcement, affects a wide disproportionality of youth of color, youth with disabilities and LGBTQ students (Redfield & Nance). Although violent school crimes have declined, suspensions and expulsions have increased. In the 2011-2012 national academic year, 260,000 students were referred to law enforcement and 130,000 expulsions were made due to minor offenses such as disruptive behavior, dress code violation and disobedience. 1% of these disciplinary actions involved firearms or explosives compared to 42.5% of disciplinary cases which accounted for insubordination (Redfield & Nance, 2016). This national issue increases the risk of school dropouts, displaces students from their schools and introduces them to the negative cycle of delinquent behavior, incarceration, and recidivism. The literature review seeks to provide clarity on the risk factors associated with the student and the school environment, and apply the critical race theory to the correlation of racial disparities and academic achievement. The restorative justice model will be utilized as a means of dismantling the pipeline and gaps in research will be exposed including the analysis of the pipeline on micro, mezzo and macro levels. This information is critical to professionals in the education, criminal justice, social work and law fields. Professionals need to be aware of this issue to help dismantle and collaborate to provide preventive models for youth. Articles were identified using JSTORE database, Google Scholar, HEINOnline and JEWL search through the MTSU library site. After reviewing 50 articles in total, 15 were selected based on the relevancy and credibility of the material. The research design will utilize research articles that focus on statistical data, background information, and its effects on minority groups. Findings from this research will be applied for the summer grant program to conduct local research.

### FADER: An Autonomous and Mobile FALL DEtection Robot

Christopher Secrest, Undergraduate student, Engineering Technology; Lei Miao (Faculty sponsor) Engineering Technology

Millions of older adults accidentally fall at home each year in the United States. Falls can lead to serious injuries and even death if they are not detected fast enough. This research aims to build an autonomous and mobile FALL DEtection Robot (FADER) that detects and reports falls. Compared with existing fall detection systems, FADER is low-cost, portable, unobtrusive, and requires no electronic devices worn by the user. The key idea of FADER is to utilize passive infrared sensors and ultrasonic sensors to follow a human and detect falls. It is also a perfect vehicle to practice robotics, instrumentation, programming, and control theories taught in MTSU's Mechatronics curriculum. This semester marks the beginning of this ongoing project. We will present the mechanical and electrical design and an early prototype of FADER. A live demo which involves interaction with the participants will be given to show the effectiveness of the human tracking algorithm. Finally, we discuss future work that will improve FADER.

Prestige as Defined by Plants: Examining the Role of Archaeobotanical Remains in the Creation of Social Landscapes at the Maya Site of El Pilar

Jessica O'Neill, Undergraduate student, Sociology and Anthropology; Andrew Wyatt (Faculty sponsor) Sociology and Anthropology

This presentation will be on my senior thesis. The thesis illuminates how archaeobotanical remains can be utilized to examine class and social differences between households at the site of El Pilar in the Maya lowlands. I combine household archaeology and landscape archaeology to examine the interconnected nature of a created landscape expressing identity in the form of class and status. This work will help demonstrate how household plant refuse can be used to discriminate information such as class and thereby understand not only the people in the household, but the society at large.

Development of Automated Image Analysis Techniques to Quantify Changes in Capsule Size, a Major Virulence Factor of the Pathogenic Yeast, *Cryptococcus neoformans*

Serenah Smith, Undergraduate student, Biology; Tiffany Guess, Undergraduate student, Biology; David Nelson (Faculty sponsor) Biology

*Cryptococcus* is a type of fungal pathogen that is found worldwide. The major species of *Cryptococcus* that causes illness in humans is *Cryptococcus neoformans* (*Cn*). The polysaccharide capsule, a primary virulence factor in *Cn*, has been studied extensively in recent decades. Well-known aspects of the *Cn* capsule are its structure and ability to modulate the host's immune response. Previous studies have shown that *Cn* strains capable of producing capsule of greater diameter, are better able to evade the host immune system as they are less likely to be ingested and destroyed by host phagocytic cells. Given the importance of capsule size to disease outcome, it is important for *Cn* researchers to be able to quickly and accurately quantify it. Current measuring techniques are tedious and subjective, and involve the use of digital microscopes to capture images of multiple cells (generally hundreds) followed by manual measurement of both the cell body and the surrounding capsule. The data is then compiled and the diameter of the capsule is calculated. There are many issues with manual measuring, most notably human error and subjectivity. The goal of this project is to develop a protocol that will provide researchers with a more accurate, reproducible, and efficient method of measuring *Cn* capsule by utilizing image analysis software. Working with DRVision, we have developed a custom algorithm for SVCell – a commercially available image analysis software package – called “Capsule Partition” that enable the automatic detection of *Cn* cell bodies and associated capsules in microscopy images and calculation of capsule diameter. Automating as much of the measuring process as possible will enable researchers to reduce—if not eliminate—the subjective aspect and human error from the measurement process, as well as making the measuring process more time efficient and leading to more reproducible data.

## A Child's World: A Qualitative Study of the Social and Cultural Construct of Kindergarten Children

Calla Sharp, Undergraduate student, Elementary and Special Education; Jane Seok Jeng Lim, Faculty, Elementary and Special Education; DeArris Boyd, Graduate student, Elementary and Special Education; Jane Seok Jeng Lim (Faculty sponsor) Elementary and Special Education

The purpose of this study is to study the social and cultural constructs of Kindergarten children. Since the Convention of the Rights of the Child (CRC), more attention and focus has been placed on voices of children. The researchers wanted to find out what children think of their school, home life and their emotions. A qualitative study was conducted with 30 Kindergarteners at a local elementary school in fall 2016. Through small group focus interview and work sample (children's drawing), in-depth data were collected. The researchers considered and evaluated how the child's unique and specific environment affects their responses in the interview and drawing portion of the study. Adopting Urie Brofenbrenner's ecological systems theory as the theoretical framework, this study explores the implication of the data on children's construct of childhood. The data will be coded and analyzed according to emerging themes. The results and findings of this research are useful to parents, educators, and education administrators across the world.

## Determining the Plausibility of Creating a Cheat Sheet for Blood Stain Analysis Using Blood Stain Circumference to Theoretically Determine a Person's Height

Shonda Clanton, Undergraduate student, Forensic Science; Hugh Berryman (Faculty sponsor)  
Sociology and Anthropology

Blood spatter and stains are common to crime scenes in which violence occurred. They are often used by law enforcement to determine the direction of travel of blood, distance from the blood source to the person or object it fell from, sequencing of the events that took place, and much more. Blood stains are a useful tool in determining what took place and how it may have physically occurred. The question is, could blood stains be used to determine the approximate height of the person that they fell from?

Low velocity blood stains are usually round or spherical in appearance unless a force has acted upon them or transfer of blood from an object has occurred. Small tails on the drops of blood allow us to determine the direction in which the blood was travelling, when present but when the person is standing still, there is no tail present. According to Blood Stain Pattern Analysis, the directionality of the stain is one of the most important factors available to an analyst (Bevel, T., and Gardner, R. 2008).

I used a theoretical situation for this study and created a wooden approximation of a fingertip to drip the fake blood. I calculated the final average velocity at which blood falls from a hand wound commonly found in those who are “unfamiliar with the use of knives and end up cutting their own hand from knife slippage” (Montgomery, 2016). I used calculated heights and circumferences of blood stains to determine that it is plausible to create a “cheat sheet” from which the approximate height of a person could theoretically be approximated from the visual study and measurements of the circumference of a low velocity blood drop falling from an assailant who is standing still at a crime scene.

### Analyzing the Correlation between Allelic Imbalances and Muscle Mass in Rainbow Trout

Jasmine McCroskey, Undergraduate student, Biology; Ali Ali, Graduate student, Biology; Mohamed Salem (Faculty sponsor) Biology

Developing genetically improved rainbow trout strains, that possess appealing phenotypes to consumers, benefits the overall profit of the agriculture industry. Large Neutral Amino Acid Transporter-4 (LAT-4) gene is necessary for the transport of Branched Chain Amino Acids (BCAAs) that are used by body builders because of their ability to increase the performance and muscularity. To study the genetic architecture of an economically important trait such as muscle yield, muscle percentage to body weight were measured in 500 fish representing 98 fish families from a growth selection line (hatch year 2010). In an effort to improve the fillet quality of rainbow trout, we analyzed the LAT-4 allele-specific gene expression in fish families showing variation in muscle yield to determine if it has any significant association in terms of muscle mass. Interestingly, sequencing LAT-4 gene identified four SNP markers exhibiting allelic imbalances in fish families with contrasting phenotypes (high versus low muscle yield). Statistical analysis showed that the four SNP markers were significantly associated with the muscle yield ( $P < 0.001$ ). In conclusion, this study facilitated identification of allelic variations associated with the trout muscularity. The LAT-4 markers are suitable for both genomic selection and genetic manipulation in aquaculture fish stocks.

## Field Performance of Variable Pervious Concrete Mixtures under Freeze/Thaw Conditions

Darius Johnson, Undergraduate student, Concrete Industry Management; Cody Martin, Undergraduate student, Concrete Industry Management; Noah Hawkins, Undergraduate student, Concrete Industry Management; Heather Brown (Faculty sponsor) Concrete Industry Management

Pervious concrete systems have been implemented in Tennessee since 1990. The long-term durability and infiltration of these systems are very important to understand so that designers can properly plan for maintenance and design life. One exposure that can shorten the lifespan of a pervious concrete system is freeze/thaw. Tennessee experiences over 60 freeze/thaw cycles per year which can be very damaging to the voids and paste keeping pervious structurally sound. Additionally, the deicer companies have developed new formulas for the bagged salts and brine that DOT agencies use to deice the road before an expected event. These deicers are typically magnesium chloride, calcium chloride or sodium chloride. The most aggressive option is magnesium chloride which has proven detrimental to the paste/aggregate bond in both normal and pervious concrete systems.

A parking lot was constructed during Summer and Fall 2016 with 75 different pervious concrete mixtures so that we could determine which mix resisted deicer most effectively. Salting occurred weekly for 3 months and then powdered samples were taken to determine chloride content of the paste/aggregate layer. The results would allow concrete producers to create mixes more resistant to freeze/thaw and deicer agents in the winter months.



## Context-Specific Action Learning in the Working Memory Toolkit

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

Machine Learning, Deep Learning, Artificial Neural Networks (ANNs): these terms name a few subfields of Artificial Intelligence (AI) that serve their purpose in solving specific engineering problems. ANNs have proven to be a bountiful subfield in AI inspired by mimicking certain biological principles, particularly focusing on the various functions of the brain. For example, some ANNs mimic the biological mechanisms underlying working memory (WM) for maintaining and processing information. The Working Memory Toolkit (WMtk) is a software library developed to integrate ANN-based WM into software and robotic systems. Holographic Reduced Representation (HRR) is a framework coupled with the WMtk for creating and combining symbolic concepts like planning and reasoning. However, a current hurdle in the WMtk is that all action-based functionality has to be explicitly programmed by the user. The overhead in knowledge and development to accomplish this task is quite burdensome. Here we use a technique called temporal difference learning (TD) to train the WMtk to learn from raw experience without a model of the environment's dynamics. TD has traditionally been used for learning external actions. However, in our application of TD, we are utilizing both internal actions (WMtk content updates) and external actions (actions necessary to complete a task) simultaneously. Combining these components in the WMtk allows systems to learn the correct actions to take in the correct context without explicit prior instruction.

## The Helpful Robotic Arm: Want One or Need One?

Kevin Neal, Undergraduate student, Engineering Technology; Chong Chen (Faculty sponsor)  
Engineering Technology

In the world of robotics, the robotic arm is one of the more popular builds among hobbyist. The arm itself consist of Servos or DC motors that help provide the movement of the joints. The rotational joints or arms in robots are described as degrees of freedom (DOF). The more degrees of freedom the arm has, the more flexible the robotic arm can become. Another essential part of a robotic arm is the microcontroller, which controls some or all of the functions of a device. As technology moves forward, more companies are looking for ways to save time, money and increase safety in the workplace. If a robotic arm is automated, it can perform a variety of tasks. Ranging from the simple task of drilling to a more complex task of assembling parts. Robots can work in places that are harmful or dangerous to the humans. Robots do not have the same safety issues as humans. For my project, I will design and build and a robotic arm with a gripper. It will be constructed using 3D printed parts made out of poly (lactic acid) PLA and will have 3 degrees of freedom. I have decided on two options for controlling the robotic arm. The first option that I have considered to control the robotic arm is using a program that will simulate the movements of all three axes. The second option would allow the user to control the robotic arm manually, using the joystick and/or knobs to control the movements of the X, Y, and Z axis. The arm has 23 printed parts total with a total print time of 80 plus hours. Once all the parts are printed, I will have to assemble the arm, connect the motors, wires, and configure the software to the microcontroller.

## Common Ideographs between President Reagan and President Trump

Connor McDonald, Undergraduate student, Communication Studies and Organizational Communication; Patrick Richey (Faculty sponsor) Communication Studies and Organizational Communication

As artifacts, I will look at the first Inauguration Speeches given by President Ronald Reagan and President Donald Trump. I chose these two artifacts because I believed it is an extremely relevant topic given the current political climate. As an individual who follows politics extremely closely, I followed the past presidential election cycle with exceptional interest since both the Republican and Democrat presidential nomination contest presented extremely unique circumstances. During this presidential election cycle, there were several times when individuals in the media and the campaigns compared Donald Trump to Ronald Reagan. Since Ronald Reagan is my personal hero, I wanted to look closer into this comparison. Watching Donald Trump's Inauguration Speech, which took place the week after this class began, piqued my interest in selecting inaugural addresses as artifacts.

For my lens, I will be using Michael Calvin McGee's concept of an ideograph. According to McGee, an ideograph is a term a politician uses that the public readily proscribes to; however, the public has a very difficult time coming to a detailed definition of the word (Denton, 2008). McGee gives examples of some ideographs: "liberty," "freedom," "division," and "security." McGee holds that for a word to be an ideograph, it must be a commonly used word, it must have a slightly ambiguous meaning, and allow for the speaker to guide the listener to his or her desired definition (Denton, 2008).

When looking at President Reagan and President Trump's Inaugural Addresses, I will look through the lens of McGee's ideograph to discuss ideographs of interest in the two speeches. Several things I will be looking for is the inclusion of common ideographs, specific exclusion of any ideographs, and potentially the change in the connotations of ideographs that has taken place since President Reagan's first inaugural address in 1981.

### Analysis of Thecamoebian Assemblages in Fall Creek Falls State Park

Samantha Addis, Undergraduate student, Geosciences; Melissa Lobegeier (Faculty sponsor)  
Geosciences

Thecamoebians, or testate amoeba, are microscopic, single-celled organisms that produce, either through agglutination or secretion, a mineralized shell. As these microorganisms vary in their life modes and are relatively short-lived, they function as excellent indicator species. By analyzing the diversity, number, and types of thecamoebian species present in a particular environment, the health of that environment can fairly accurately be assessed.

For this URECA project I collected multiple sediment samples from 3 locations at Fall Creek Falls State Park to test for possible environmental degradation. As State Parks are important to both the economy of the state and the health of the local ecosystems overall, it is crucial that they be monitored and protected against potential environmental threats. Through this project, the health of three main bodies of water in the park were analyzed for environmental degradation.

All samples have been collected, washed, and the thecamoebian shells present have been separated and placed onto microscope slides. Preliminary analysis of the samples shows a relatively high concentration of species in the genus *Diffflugia*, as well as considerable number of species in the genus *Centropyxis*. This high ratio of *Diffflugia* to *Centropyxis* could be indicative of eutrophication, but analysis of the remaining samples is required before final conclusions may be drawn. Any evidence of environmental stress detected will be passed on to the park's administration and the Division of Natural Areas for Tennessee State Parks.

Problem Solving as a Potential Markers of Cognitive Ability in Anteaters (Myrmecophagidae) living at Nashville Zoo

David Pitchford, Undergraduate student, Biology; Danielle Brown, Faculty, Biology; Danielle Brown (Faculty sponsor) Biology

Cognitive abilities such as memory, pattern recognition, and problem solving are marks of intelligence in nonhuman animals. Intelligence can play a role in whether an animal can overcome novel challenges within its natural environment. While captive animals are safe from predation and food insecurity, more intelligent animals often suffer boredom and stress from under-stimulation. Generations in captivity may also make reintroduction to their natural habitat more difficult if they fail to stay mentally flexible and solve problems within their new environment. Understanding an animal's cognitive capabilities should inform protocols for maintaining mental welfare in captivity and pre-release training before reintroduction to the wild. Anteaters (Family: Myrmecophagidae) diversified early in mammalian evolution. Their specialized olfactory sense allows them to locate and revisit concentrations of their insect prey, but they are considered primitive relative to other mammals, leading to an assumption of low cognitive capability. Anteaters are popular in zoo collections, and captive populations represent the only source for reintroductions into parts of their historical range. To challenge assumptions of low intelligence, and to inform protocols for captivity and reintroduction at Nashville Zoo, we presented 18 individuals of two anteater species with a novel puzzle which rewarded successful problem solving. Videos presentations were scored for latency to approach, latency to solve, and diversity of exploratory behaviors. There were no inter-species differences in approach latency (mean =  $50.1 \pm 11.8$  seconds) or exploration diversity scores (mean =  $5.3 \pm 0.19$  behaviors). Tamanduas took an average of 55.9s, twice as long to solve the puzzle as giant anteaters (F-statistic 5.63,  $p = 0.035$ ,  $n = 14$ ). Species also differed in the behaviors used to problem-solve. Ninety-Five percent of the variation in exploration diversity scores were intra-specific, indicating individual differences in exploratory behavior. Future analyses will quantify these differences and examine their stability over time and across contexts.

## Synthesis and Liquid Crystalline Properties of Selected 12-Pyridinium Derivatives of [*closo*-1-CB<sub>11</sub>H<sub>12</sub>]<sup>-1</sup> Anion

Kenya King, Undergraduate student, Chemistry; Beata Lukasik, Visiting scholar, Chemistry; Piotr Kaszynski, Faculty, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

The chemistry of [*closo*-1-CB<sub>9</sub>H<sub>10</sub>]<sup>-1</sup> is well advanced [1] and many liquid crystalline derivatives have been investigated [2], yet the analogous synthetic transformations and investigations of [*closo*-1-CB<sub>11</sub>H<sub>12</sub>]<sup>-1</sup> are few [3]. Here we report the efficient preparation of 12-pyridinium derivatives of [*closo*-1-CB<sub>11</sub>H<sub>12</sub>]<sup>-1</sup>, and characterization of their liquid crystalline properties. In the first step, pure [*closo*-1-CB<sub>11</sub>H<sub>12</sub>]<sup>-1</sup> Cs<sup>+</sup> is treated with *n*-BuLi in the presence of tetramethylethylenediamine (TMEDA) and then subsequently reacted with the appropriate iodoalkane C<sub>n</sub>H<sub>2n+1</sub>I (n = 5, 10) to afford [*closo*-CB<sub>11</sub>H<sub>11</sub>-1-C<sub>n</sub>H<sub>2n+1</sub>]<sup>-1</sup> Cs<sup>+</sup>. Iodination with PhI(OAc)<sub>2</sub> in 80% TFA gave a series of [*closo*-CB<sub>11</sub>H<sub>10</sub>-1-C<sub>n</sub>H<sub>2n+1</sub>-12-IPh] with small amounts of the [*closo*-CB<sub>11</sub>H<sub>10</sub>-1-C<sub>n</sub>H<sub>2n+1</sub>-7-IPh] isomer. The 12-isomer was heated with selected 4-alkoxy pyridines at 55 °C for 24 h to yield 12-pyridinium derivatives of [*closo*-1-CB<sub>11</sub>H<sub>12</sub>]<sup>-1</sup>. Target compounds were tested using differential scanning calorimetry (DSC) and polarizing optical microscopy (POM) and some structures were determined by X-ray diffraction analysis. This project is supported by NSF DMR-1611250.

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## Middle Tennessee State University's Legacy in Forensics

Katelyn Brooks, Undergraduate student, Communication Studies and Organizational Communication; Patrick Richey (Faculty sponsor) Communication Studies and Organizational Communication

Forensics, commonly referred to as speech and debate, is rooted in Ancient Greek philosophy and philosophers such as Socrates, Plato, and Aristotle. Spanning across millennia, forensics has evolved alongside societies. In Ancient Greece, forensics was rooted in governmental contexts in order to educate eligible voters and to be civically and logically engaged. Since then, forensics has merged with various academic fields, such as rhetorical studies and theories of persuasion. Beyond academia, forensics has become both competitive and social. Forensics teams exist on multiple levels of educational institutions from middle and high school to collegiate. At Middle Tennessee State University since its inaugural year in 1911, some form of a debate team has existed. While still Middle Tennessee State Normal College, four literary societies (two for men and two for women) debated each other and other Normal Colleges in Memphis and Knoxville. The topics largely revolved around literature and current events. Eventually, the societies gradually declined until the late 1930s. The original "debate club" was formed in 1927. Debate and forensics has continued to exist at MTSU since then, experiencing periods of growth and decline in between. In December of 1952, Pi Kappa Delta, the national forensics honor society, was chartered and created at MTSU and still continues. The Debate Team has proven to be successful and competitive in multiple debate formats and speech events. The team currently displays over 700 trophies, but the oldest is only from 1958. Additionally, there are around 300 individual documents, such as news articles and team records. The legacy of the Debate Team(s) at MTSU has been largely forgotten by the majority of students and should be remedied. The team's historical artifacts have already been cataloged, but now should be made known to the student body, faculty, and administration.

### Innovation for Critical Languages: Curriculum and Materials Development for Japanese Language and Culture Instruction

Rebecca Clippard, Undergraduate student, Foreign Languages and Literatures; Shelley Thomas (Faculty sponsor) Foreign Languages and Literatures

The goal was to create and teach a summer Japanese class for MTSU's Center for Accelerated Acquisition (CALA) using brain-based research for long-term language acquisition. Forged through years of practice in the classroom, the brain-based approach is also supported by research in the fields of psychology and second-language acquisition. The method for creating the new CALA Japanese curriculum is based on the foundational research in Total Physical Response, Teaching Proficiency through Reading and Storytelling, Comprehensible Input as well as the practical applications found in the works of language acquisition and brain researchers. This approach results in natural, stress-free acquisition, and long-term retention of languages by engaging both hemispheres of the brain. CALA's approach to language learning involves lots of movement, interaction, and learning in context—such as through stories. I created a new course curriculum, which included all learning goals, objectives, and concomitant activities that can be used by other language teachers, and taught two week-long summer classes utilizing the brain-based approach. Grammar and vocabulary were taught in the context of real-world communication and conversation in order for the students to have 100% comprehensibility. A CALA Japanese class has the potential to provide standardized test data showing how quickly Westerners are able to learn a non-western language. Japanese is typically considered to be difficult to acquire due to its notable differences to western languages, but the summer class provides evidence that difficult acquisition might actually be a misconception. Adding Japanese to the CALA offerings addressed a significant language-learning need for the global community and provided state-of-the art materials for the teaching profession.



### Using Lee-Carter Model and Max Factor Model to Forecast Mortality Rate

Zhao Wang, Undergraduate student, Mathematics; Chuqiao Song, Undergraduate student, Mathematics; Khaliq Abdul (Faculty sponsor) Mathematics

This paper uses Lee-Carter model and Max Factor model to forecast the mortality rate. First, we use the Lee-Carter model to represent the data of the U.S. male mortality from 1933 to 2014. We retrieved the data from mortality.org, (select U.S.A. and navigate to life tables). Also, we used R code with Demographic Methods to calculate the mortality rates.

In this presentation, we first analyze detailed changes of the U.S. mortality rate over the 20th century, and then use the data from 1933 to 1987 to calculate parameters  $\alpha$ ,  $b$ , and  $k$ . As a test, we used the parameters to forecast the mortality rate in 2014. Finally, we forecasted age-specific mortality in 2050 starting from 1989.

As a result, the Lee-Carter model seems to be a reliable way to forecast the mortality rate, and the result of forecasting will not be negative. In the second part of this paper, we show what the max factor model is, and how to use the R language to draw the diagram with the data from Standard & Poor's index. The data shows default rate from 1980 to 2010, comparing with the data from calculating with R language and the real default rate to prove feasibility of the max-factor model. By comparing the past model and the max-factor model, it is possible to figure out the advantages of using the max-factor model into a wider range, specifically to forecast the death rate for different diseases.

## Why Are Some Countries Happier than Others?

Jeffery Slatton, Undergraduate student, Political Science; David Carleton (Faculty sponsor)  
Political Science

In recent years, countries have become concerned with the happiness of the people who inhabit their borders. A people's happiness has been linked to the success of the country in areas like the government and economy.

The main question is what makes the people of a country happy. To answer this, I identified four independent variables in literature related to this topic. Women in government, gross domestic product (GDP) per capita, religion, and freedom were the factors that I decided to test.

I chose the United States, the United Kingdom, India, and China as the countries to look at the independent variables in. The reasoning for these countries is the United States and United Kingdom are well-developed world powers, while India and China are emerging world powers. These countries are in different areas of the world and vary in types of governments, population size, and cultures. These differences help to validate the factors for happiness as across the board for all countries and not just for a specific criterion.

## Flow Control

Salman Rahmani, Undergraduate student, Aerospace; Marco Hanna, Undergraduate student, Aerospace; Dalal Jondoul, Undergraduate student, Aerospace; Mark Callender (Faculty sponsor) Aerospace

As a Class-8 truck accelerates, it creates a rift within the airstream that it is traveling within. As the air particles separate around the front of the vehicle and re-attach at the rear, it creates a region in which the air particles “tumble” and create a fundamental force known as drag. This drag, also known as pressure drag, hampers the vehicle’s ability to heighten or maintain its desired velocity.

This project attempted to examine whether 2-dimensional drag reduction methods, would yield the same outcomes on a 3-dimensional representation. In addition to testing already-studied modifications, extensive observations were also conducted on a theoretical design which included rotating cylinders whose surface was tangential to the trailing edge of the 3-D geometry. The tested rotational speeds of the cylinders were twice the speed of the flow, matching the speed of the flow, and with no rotational speed. The results of these examinations will be the focus of the presentation. If satisfactory drag reduction is achieved, this project may possess applications beyond just Class-8 trucks and instead, shed some light on how various factors play a part in aerodynamic drag. The software that is being utilized for these simulations is ANSYS-Fluent. This study was carried out in the Aerospace Technology Laboratory with URECA funding.

### Deletion in WFS1 Gene is Associated with Muscle Tenderness in Rainbow Trout

Robert Lechleiter, Undergraduate student, Biology; Mohamed Salem (Faculty sponsor) Biology

In the industry of cultivating fish for consumption, fillet quality attributes that appeal to the consumer's sense of taste such as the muscle tenderness are important for industry and consumers. Genotype-based selection will help develop genetically improved strains with the desirable phenotypes. Wolframin (WFS1) gene regulates  $Ca^{2+}$  level that contributes to post-mortem muscle tenderization by activating  $Ca^{2+}$ -dependent proteases (Calpains). Phenotypic data for muscle tenderness were collected from 500 fish representing 98 fish families from a growth selection line (hatch year 2010). In this study, RNA-Seq (transcriptome sequencing) of 22 fish families (5 fish each) exhibiting contrasting phenotypes were generated. Two computational pipelines (GATK and SAMtools) were used for calling deletions in the WFS1 gene. Two deletions were potentially tested for association with fillet tenderness. A single deletion of 59 nt long in the WFS1 gene showed statistical significance in association with muscle tenderness ( $P < 0.02$ ). Deletions in WFS1 gene could serve as genetic markers to select fish for improved muscle tenderness.

## The Application of Chlorine Dioxide Gas as a Bactericide Agent

Roderick Moore, Undergraduate student, Chemistry; Beng Ooi, Faculty, Chemistry; Beng Ooi (Faculty sponsor) Chemistry

Chlorine dioxide has been used as effective disinfecting agents in hospitals, food manufacturing facilities and water treatment plants. This study investigates the biocidal effects of gaseous chlorine dioxide on *Escherichia coli* K-12 cells in media solution. The main focus of this research is to determine the concentration of chlorine dioxide and the exposure time needed to kill up to  $2 \times 10^9$  cells. *E. coli* cells were exposed to chlorine dioxide gas produced using 0.5 grams of precursor A and activator B for various time periods of 1.0, 1.5 and 2.0 hours. The BacLight bacteria viability assay and fluorescence spectrometry technique was used to determine the ratio of live to dead cells in untreated and chlorine dioxide treated samples. In the one-hour treatment, *E. coli* cells were exposed to chlorine dioxide levels up to 1.05 mM, resulting in the inhibition of about 95.17% of the treated cells, whereas with the longer exposure time of 2 hours, the cells were exposed to higher concentrations up to about 2.30 mM, killing all of the  $3.01 \times 10^7$  treated cells.

### Investigating the Effect of Pesticides on Soil Microbe Cultures

Araceli Lopez Alvarez, Undergraduate student, Chemistry; Alissa Green, Undergraduate student, Chemistry; Ashleigh Roeser, Undergraduate student, Chemistry; Emily Best, Undergraduate student, Chemistry; Taylor Orr, Undergraduate student, Chemistry; Sequence McCollough, Undergraduate student, Chemistry; John DiVincenzo (Faculty sponsor) Chemistry

With continued interest in pesticides, but growing criticism, this project aimed at investigating the effects of pesticides on nitrifying bacteria, specifically from soil and waste water and general soil microbes. Nitrifying bacteria were chosen specifically due to their immense role in the soil and water's ecosystem by converting ammonia to nitrate, an essential nutrient to the ecosystem. The possible effects were tested via three different techniques which included: observing any changes in the nitrate production of the microbes, fluorescent microscopy and spectroscopy to observe the live: dead ratio of bacterial cells, and respiration chambers to capture carbon dioxide. Respiration chamber studies showed a 98% reduction in CO<sub>2</sub> production by soil microbes when exposed to Malathion. Fluorescent microscopy and spectroscopy studies showed that more than half of the bacterial growth was affected by exposure to pesticides (Malathion and 2,4-D). Additionally, nitrate production, monitored by ion chromatography, HACH Method 8171, and a modified MPN method, was decreased after exposure to both pesticides. Overall, all the methods provided evidence that indicates a decrease in nitrifying bacteria growth and their processes. The research is continuing in an attempt to study the nitrifiers in greater detail and more closely mimic natural environments. This is being done by constructing soil columns and measuring nitrate levels by comparing normal soil to soil spiked with pesticides. Additionally, the research is expanding to also investigate the effects of pesticides on nitrogen fixing bacteria, the microbes involved in capturing the nitrogen from air. This is being done via plating methods and fluorescent spectroscopy. While pesticides are applied in an attempt to benefit the plants of interest, this research demonstrates one potential negative effect of this practice.

“Breaking Bad” Forensic Analyses: Various Drain Cleaner Effects on the Analysis of Molecular Integrity of *Sus scrofa* DNA

Kimberly Warren, Undergraduate student, Forensic Science; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

Gang violence as well as violent homicides are prevalent in large cities across the United States. In popular media, such as the popular show *Breaking Bad*, characters involved with drug violence or serial killings dispose of victims' bodies by using harsh chemicals, including drain cleaners. Without an intact body at a homicide crime scene, criminalistics teams must establish a post-mortem timeline associated with the crime using methods other than visual identification, such as DNA identification. This study uses pig rib tips as a surrogate for human flesh to analyze the effects of various drain cleaner on the DNA analysis. The rib tips were exposed to acid, base, and enzymatic based drain cleaners for a two-week period (in triplicate), with DNA samples extracted and isolated daily. Nanodrop was used to analyze the concentration of DNA for each sample. Current results show that DNA could be isolated from nearly all samples for all time points. The integrity of isolated DNAs is currently being analyzed using PCR for two alleles. This study will provide insight into loss of forensic DNA integrity using common household drain cleaners.

Behavioral and Physiological Responses to Simulated Predator Induced Stress in the Eastern Box Turtle, *Terrapene carolina carolina*

Victoria Lay, Undergraduate student, Biology; Matthew Klukowski (Faculty sponsor) Biology

The behavioral and physiological responses of eastern box turtles, *Terrapene carolina carolina*, to a simulated predatory encounter were measured. Wild box turtles were randomly assigned to a stimulus intensity group, which consisted of observation (control), a visual stimulus, a poke on the leg, or a pinch on the leg before being flipped. Behavior in response to the stimulus was observed from a distance for 5 minutes, except for the control which was observed for 15 minutes. Immediately after the observation period, turtles were captured and had a small blood sample taken, after which a pinch gauge was used to measure the shell's closing force. The results indicate that the stronger the simulated predatory stimulus, the stronger the behavioral responses, with the turtles taking more advantage of their fully closable shell at the more intense stimulus groups. However, stimulus intensity did not affect the plasma corticosterone or plasma lactate response. This may be due to too short or weak of a stimulus, increased parasympathetic activity, or seasonal effects. Upon capture and during handling almost all turtles withdrew into their shells and closed their anterior plastron, although fewer actually closed their posterior plastron, and a few engaged in other behaviors such as biting, urinating, and air walking. There appeared to be a correlation between box turtle size and pinch strength; however, the relatively large size of the pinch gauge may have put smaller turtles at a disadvantage compared to larger turtles because of excessive stretching of their closing muscles. The results of this study indicate that in spite of their fully closable shell, box turtles exhibit a complex, graded response to perceived threats. This strongly suggests that full closure of the shell is likely to be costly and occurs only in response to the most intense stimuli.



## Textiles Printing

Andres Martinez Garcia, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor)  
Human Sciences

Digital printing is one of the most exciting developments in the textile industry, one problem that many designers have is finding the right pattern and design for their fabrics. To solve this problem, I have researched and learned how to use the HP Designjet Z5200 to print over textiles, and that we can choose from a huge variety of fabrics such as silk, polyester and cotton. Printing textiles with HP Designjet Z5200 is an easy, practical and unique way of having total control over our fabric design to make a final garment or any other creative project. Indeed, we can use any program such as CAD or Illustrator to make our designs and then transfer them into our fabric. I learned that the process of printing over textiles is really simple, and that we only have to select the design, then adjust the dimensions and print it, is that fast. For instance, I have used some of the designs that I made to make wall posters, which demonstrates that this could even be used for interior design. My research proves that there is a high demand on this new technology, and that it opens the opportunity for cost reductions and capacity to customize a fabric. Overall, I intent to pursue students and/or anyone interested on printing textiles to try HP Designjet Z5200, learn how to use it and develop a new skill that can be beneficial for their future.

### Why Write Fanfiction: A Brief Ethnographic Survey

Kellye Guinan, Undergraduate student, Sociology and Anthropology; Ida Fadzillah Legget  
(Faculty sponsor) Sociology and Anthropology

In understanding the reasons behind why people write fanfiction and what roles this plays in online culture, we need to know who these people are: what groups they represent and what types of things they choose to write about. As the internet saturates more of the everyday world, the way people transform their media, the legends of the modern day, becomes a way to glimpse at the new perspectives developing in Western culture. By examining the overarching themes of respondents, cultural researchers can see how people interpret their interactions with others and with the media that means the most to them. We may begin to understand how people, especially women and non-binary individuals, subvert cultural norms by reinventing the characters and situations contained in the most popular genres. This poster reflects the results of a survey conducted in January and February that asked respondents to explain their choices in reading and writing fanfiction.

Bittersweet *Lemonade*: Hurston, Beyonce, and the Haters

Katherine Clemens, Undergraduate student, History; Laura Dubek (Faculty sponsor) English

Best known for her novel *Their Eyes Were Watching God* (1937), Zora Neale Hurston was also an accomplished folklorist and anthropologist. Today, *Their Eyes* is considered to be a classic piece of African American literature. When the novel first appeared, it received criticism for its portrayal of black culture, especially its use of the vernacular. Many, including her contemporaries in the Harlem Renaissance, felt the novel perpetuated stereotypes and pandered to white audiences. Five-time Grammy award winner Beyonce has also received criticism for her portrayal of black culture in her visual album, *Lemonade* (2016). My project examines the lyrics and visuals of *Lemonade* alongside the text of *Their Eyes Were Watching God* in order to draw parallels between two black women artists working in completely different time periods. In addition to literary analysis, I will consult reviews of and commentary on each woman's work, biographical materials identifying their intent, and historical sources that help me determine whether the audience and cultural climate for black women's art have changed in the last 80 years. My audience is anyone with an interest in African American Studies, Women and Gender Studies, English, Anthropology, and History.

### Parallel Manipulator Robot for Use as an MTSU Instructional Aid

Aldair Nieto, Undergraduate student, Engineering Technology; Justin Woods, Undergraduate student, Physics and Astronomy; Brian Slaboch (Faculty sponsor) Engineering Technology

When it comes to learning course material, a visual aid of key course concepts may be one of the most effective ways to stimulate and motivate student interest in studying and understanding the material. The effectiveness of a visual aid was the purpose of the 2016 Fall semester of research completed by the project team. In the Fall 2016 semester of research, the objective was to complete a design for a type of robot known as a 3-RPR Parallel Manipulator, so that construction of the robot could begin in the 2017 Spring Semester. The completed robot will be used as an instructional aid in the Dynamics, and Kinematics and Dynamics of Machinery courses offered at MTSU.

The completed robot should be of great benefit to both students and instructors in the classroom. In addition, the completed robot can be used to assist in other departmental research projects, where it may serve as a platform to implement other Engineering Technology departmental related research such as interfacing the robot with the Xbox Kinect motion sensing device, or implementing variable joints to determine if it improves the performance of the robot.

During the 2016 Fall Semester, the major preparatory work needed for the construction of the robot was completed. This includes creating a design for the robot, drafting the created design within a CAD Software, creating a part list, and creating the mathematical equations that will be eventually implemented into the algorithm that determines the robot's functionality. Also, in this Spring Semester, the parts have been ordered and the project team is currently machining the robot's custom parts at the MTSU machine shop.

## Human Hand Gesture Recognition, Using the Microsoft Kinect Sensor

Aldair Nieto, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor)  
Engineering Technology

The evolution of computer vision in the last decade has greatly improved and has gained an immense amount of popularity in the field of robotics. Understanding the complexity of computer vision is very difficult. As human beings, we are trained to recognize the environment around us, so we must also train a machine to do same. The aim of the project was to gain a fundamental understanding in hand recognition using the Microsoft Kinect sensor. During the Spring 2016 semester I analyzed the Kinect's infrared capabilities and how to use the Kinect to recognize hand gestures by implementing an open source algorithm. This included controlling a custom built robotic arm with hand gestures. The completion of the project required skilled implementation of robotics, programming, and control algorithm knowledge. Also, the results from this project can assist in other departmental research by opening new possibilities in areas such as, robotic vision, infrared mapping, and robotic vision programming.

### Parallel Manipulator Robot for Use as an MTSU Instructional Aid

Justin Woods, Undergraduate student, Physics and Astronomy; Aldair Nieto, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

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Assessment of Anti-Herpes Simplex Virus Type 1 Activity in *Bidens biternata* and *Mangifera persiciformis*

Darcy Tabotabo, Undergraduate student, Biology; Stephen Wright (Faculty sponsor) Biology

The disease known as herpes, caused by herpes simplex virus type 1 (HSV), is a common infection resulting in lesions on the mouth or genitals. At least half of the population of the United States has experienced infection by HSV. There is presently no preventative vaccine for HSV, and resistance to acyclovir, the only currently available therapy, is increasing. This signals a need to find other chemotherapeutic agents to use in treatment. This research is evaluating extracts from two plants, *Bidens biternata* and *Mangifera persiciformis*, both used in traditional Chinese medicine, for potential anti-herpes properties in a cell culture system. *Bidens biternata* showed 6% cytotoxicity from its most active fraction; however, this fraction failed to reliably inhibit HSV. We report an unknown isolated compound from *M. persiciformis* that has shown around 70% virus inhibition with 6% cytotoxicity at 50 g/mL that is currently being evaluated for structural identification.

### Why do Some Latin American Countries Experience More Net Migration Than Others?

Hayim Juarez Del Moral, Undergraduate student, Political Science; David Carleton (Faculty sponsor) Political Science

This project explores what factors influence the net migration over various countries in Latin America. After researching, I found that unemployment, homicides and natural disasters are considerable issues affecting the rates of chosen countries. Rising unemployment rates are expected to have a negative impact on net migration. As homicide rates rise, net migration should lower. As natural disasters increase, net migration should lower. Both the economic and societal factors are largely discussed and present information on how true existing arguments are today. The environmental factor is a new correlation that hasn't been discussed enough which may describe a countries ability to react efficiently. The best topic to focus on is the homicide rates as it proves to be very close to net migration patterns. Lastly the unemployment rate patterns hold a controversial statistic of Mexico and their economic abilities.



Differential Gene Expression in *Cryptococcus neoformans*

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

*Cryptococcus neoformans* is facultative intracellular parasite fungus which is responsible for over 600,000 deaths of immune suppressed patients per year. The yeast has several virulence factors such as the polysaccharide capsule, metabolism and white blood cell counts in immunosuppressed individuals. This study aimed to identify and distinguish genomic expression of polysaccharide capsule size from clinical and wildtype strains. The study obtained clinical strains from HIV positive patients from Botswana (4 male, 3 female). RNA sequencing was completed on the clinical and wildtype strains and genes that were found to be up or down regulated by 2-fold were identified. RNA analysis was completed using Cyverse Discovery Environment and a PERL script was written to determine differential genomic expression. Gene ontology is currently ongoing on differentially expressed genes to identify which genes are responsible for capsule production. Once completed, this study will create a better understanding of genomic expression in the yeast.

## Synthesis of Highly Polar Pyridinium Liquid Crystals Derived from the $[closo-1-CB_{11}H_{12}]^{-1}$ Anion

Muhammad Osama Ali, Undergraduate student, Chemistry; Anas Hajhusein, Undergraduate student, Chemistry; Beata Lukasik, Visiting scholar, Chemistry; Piotr Kaszynski, Faculty, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

Substitution of the  $[closo-1-CB_{11}H_{12}]^{-1}$  cluster with 4-alkoxypyridinium fragments and pentyl or decyl alkyl groups yields highly polar liquid crystals. This class of compounds is expected to exhibit a nematic phase along with a substantial dielectric anisotropy resulting from a high molecular dipole moment, hence of interest for LCD applications. The new pyridinium derivatives,  $[closo-1-CB_{11}H_{10}-1-(4-alkoxypyridinium)-12-alkyl]$  will be compared to those of the previously synthesized derivatives of the  $[closo-1-CB_{11}H_{12}]^{-1}$  anion consisting of different 4-alkoxypyridinium and alkyl groups, which were previously reported [1,2]. Thus, the amine derivative,  $[closo-1-CB_{11}H_{11}-1-NH_3]$  is iodinated to form a mixture of two isomers which are then separated by crystallization. The desired 1,12 isomer is then coupled with a Grignard reagent with the appropriate alkyl group ( $C_5H_{11}MgBr$  and  $C_{10}H_{21}MgBr$ ). The resulting product is then reacted with each of the pyridinium triflates formed from triflic anhydride and primary alcohols including nonanol, decanol and undecanol to give the final product. In this presentation, we will report progress on the synthesis and characterization of the new compounds and compare with the short homologous series of the  $[closo-1-CB_{11}H_{11}]^{-1}$  cluster. This project is supported by NSF DMR-1611250.

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[2] Pecyna, J.; Pocięcha, D.; Kaszynski, P. Zwitterionic pyridinium derivatives of  $[closo-1-CB_9H_{10}]$ - and  $[closo-CB_{11}H_{12}]^{-1}$  clusters as high  $\Delta\epsilon$  additives to a nematic host, *J. Mater. Chem. C.* **2014**, *2*, 1585-91.

## Smart Traffic Light Controllers

Maryam Sedhom, Undergraduate student, Engineering Technology; Lei Miao (Faculty sponsor)  
Engineering Technology

Today's traffic light uses highly suboptimal fixed-cycle signaling, which aggravates traffic congestion and wastes energy in urban areas. The advancements in technology make it possible to collect and transmit vehicle information (destination, velocity, location, etc.) to the traffic light controller. In this project, we focus on a single intersection and utilize the vehicle information to design a smart traffic light controller. Our goal is to increase the throughput while providing certain Quality-of-Service (QoS) guarantee to the vehicles. Traffic light scheduling is a hard problem because it involves both time-driven and event-driven dynamics. Different from existing research, the novelty of this work is two-fold: (i) We associate each vehicle with a deadline in traffic scheduling and (ii) We include the vehicle's dynamics involving driving force and velocity in our calculation. In this poster, we show some preliminary results of the research. First, we derive the lower and upper limits of vehicle deadlines using best-case and worst-case analysis and mathematical induction. Second, we design an adaptive traffic light scheduling algorithm which maps real-time traffic information into vehicle deadlines and maximizes the throughput. Lastly, we use simulation to show that our approach can significantly increase throughput while providing real-time QoS guarantee.

### Autonomous Object Retrieval Robot

Jonathan Bogasky, Undergraduate student, Engineering Technology; Derek Tilford, Undergraduate student, Engineering Technology; Bader Alfouzan, Undergraduate student, Engineering Technology; Essa Ibrahim, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

With the advances of wireless communications, embedded systems, and control, robotics has emerged from science fiction to reality. It is such an important and exciting field nowadays and has great potential to make a significant impact to health care, automobile industry, manufacturing, military missions, space programs, etc. In this project, we build autonomous robots with sensing, wireless communication, and computing capabilities. The battery powered robots with mobility are designed by students in Mechatronics Engineering at MTSU and are also equipped with Raspberry PI, embedded Linux, Wi-Fi, and various sensors such as ultrasonic sensors and gyroscopes. These robots are used in various collaborative sensing and control research projects. This particular robot is designed to, both manually and autonomously, retrieve a coffee mug for the user. Detailed mechanical and electrical design of the robot will be included in the poster.

## Gender Identity in Islam

Holly Akin, Undergraduate student, Social Work; Adrianna Brown, Undergraduate student, Global Studies and Cultural Geography; Chloe Wallace, Undergraduate student, Psychology; Rebekka King (Faculty sponsor) Philosophy

James Cox has outlined the World's Religion Paradigm as a Christian narrative in which westerners project their preconceived ideological beliefs onto other religions against the Christian framework (Robertson 2013). Through this context, it can be argued that the world's religion paradigm is actually a religious description, or even perhaps a social perspective, that defines how people and their belief systems can interrelate to, or be oppositional from, one another. However, it appears that theories can be interchangeable, particularly in regards to women, because the Western and Christian bias assumes that all religions operate under common conditions or with similar purposes. The parallels may even go unnoticed to some because it does not fit their personal narrative of who they are and what their religion means to them. My intention is to guide the viewer through the World's Religion Paradigm with gender identity within Islam as the point of reference. Additionally, I would like to establish the ways in which gender identity is fluid within religion itself because using differing theoretical frameworks from dissimilar religious traditions can still illustrate the same narrative. I plan to introduce an interview with the former Imam of the Islamic Center of Murfreesboro, as well as a booklet provided on the Islamic Center's website, to further establish how women within that specific community have expectations of behavior placed upon them and a prescribed way of dress that reinforces societal roles through religious acculturation. Additionally, I will speak to the ways that social perspectives, not just religious ones, have a strong impact on women's experiences: religious and otherwise.

Characterization and Structure-Activity Relationship of an Antimicrobial Peptoid Against the Fungi *Cryptococcus neoformans*

Scott Armstrong, Undergraduate student, Chemistry; Ashley Corson, Undergraduate student, Chemistry; Kevin Bicker (Faculty sponsor) Chemistry

There is an ever-increasing number of pathogenic fungi vying to infect and overcome the weakened defenses of critically ill and immunocompromised patients around the world. As human populations increase, so too does the number of microorganisms capable of defeating current treatments. One such microorganism, the pathogenic fungi *Cryptococcus neoformans*, presents a unique research opportunity due to the shortcomings of current therapeutic options. Our research group has hence investigated the development of novel antimicrobial compounds known as peptoids. Antimicrobial peptoids mimic disease fighting molecules that are found naturally in the human body. However, peptoids possess many favorable attributes that make them much more drug-like. Through our research group's patented and published methods, a peptoid with broad-spectrum antifungal efficacy against several strains of *C. neoformans* has been discovered. This molecule, known as AEC5, has since been confirmed as a drug lead. A structure-activity relationship (SAR) analysis of AEC5 is currently underway. The results of the SAR have the potential to identify novel analogs with improved therapeutic potential. The future direction of this research will begin with the most potent compounds discovered from the SAR. AEC5, and the compounds discovered through the SAR, will be characterized for mechanism of action and evaluated for cytotoxicity in mammalian cells-such as; erythrocytes, HPL1A lung cells, HepG2 hepatocellular carcinoma, and NIH/3T3 fibroblasts.

### Mailbot: The Autonomous Mailbox Team 2

Joe Beck, Undergraduate student, Engineering Technology; Ayman Yaseen, Undergraduate student, Engineering Technology; Davis Phoxay, Undergraduate student, Engineering Technology; Mohannad Aldujaili, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

There are an estimated 200 fatalities and 9,000 injuries each year caused by mailboxes and their supports. Additionally, there are roughly 30 million people in the United States that have difficulty walking. Due to difficulty walking, it can be difficult to both deliver and retrieve mail from a standard mailbox. MailBot will help to mitigate these issues by providing autonomous mail delivery and retrieval. MailBot has the capability to be programmed to deliver mail to the curb of a driveway at a certain time during the day. In addition, MailBot can be sent out to deliver mail to the curb when it is convenient for the user. When mail exchange has occurred, MailBot will automatically return to its home position. MailBot has the capability to avoid obstacles throughout the mail delivery and retrieval process. Features of Mailbot include: Wireless Bluetooth communication with any smartphone, manual control as well as autonomous movement, and slick mechanical design.

### Mailbot: The Autonomous Mailbox

Sarah Gunger, Undergraduate student, Engineering Technology; Maryam Sedhom, Undergraduate student, Engineering Technology; Bryan York, Undergraduate student, Engineering Technology; Daniel Morgan, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

Normal everyday activities can be overlooked, yet cause accidents and fatalities. A prime example is improperly placed mailboxes and mailbox related accidents. With an estimated 200 fatalities and 9,000 injuries incurred yearly from this small task, this has become an issue that requires a solution. In addition to general mailbox safety, there are over 30 million Americans plagued by disabilities affecting their mobility and making such a menial job as walking down the driveway nearly impossible. To meet this need, a group of MTSU engineering students have designed and begun construction on a mobile mailbox, named MailBot, that will replace the human need to retrieve and deliver mail. The robot will be programmed to stay within a certain safe distance of the curb and will be have the ability to both manually and autonomously deliver/retrieve mail curbside, while avoiding obstacles, and navigate back to a home base with the delivered mail. Currently, the students have completed the design and are in the process of finishing the build. Programming has begun on manual control of the robot, including raising and lowering the mailbox to meet the mailman and traversing the driveway.



### Select Ethnic Enclaves and their Cultural Indicators in Nashville, Tennessee: Nolensville Road

Kelsey Massey, Undergraduate student, Global Studies and Geography; Doug Heffington  
(Faculty sponsor) Global Studies and Geography

This project seeks to explain the cultural footprint of Nolensville Road in Nashville, Tennessee. It does so by documenting ethnic enclaves, which are specific areas where one or more particular ethnicity resides. Ines Miyares' work defines and explains ethnic enclaves through indicators such as language, script, toponyms, flags, and colors. This project frames and explains the ethnic landscape of Nolensville Road through these indicators. It is also argued that Nolensville Road possesses other important indicators such as religious structures, retail stores, and restaurants. This will be done by documenting the current indicators through photography. Dr. Jim Chaney has also done significant work documenting migration within and subsequent settlement in the Nashville area and research will serve as a large contributor to this project. Ethnic enclaves fluctuate and change each year as people migrate. This project provides a snapshot of the current ethnic neighborhoods and settlement tendencies in the area of study. Academics and researchers interested in immigration will be able to utilize this study to understand the current landscape. Research compiled will also serve to create a lesson plan designed for 9th-12th grade social studies classrooms in order to foster understanding and appreciation for diversity and cultural studies.

### School Nutrition Recipe Development and Evaluation: Meatball Ciabatta Sandwiches

Kristen Peterson, Undergraduate student, Human Sciences; Kati Pittman, Undergraduate student, Human Sciences; Lisa Sheehan-Smith (Faculty sponsor) Human Sciences

The purpose of this study was to find a recipe that would meet the nutrition standards for school meals for a new ciabatta bread. The goal was to find a sandwich that the students would enjoy as much as the salads which were served as an alternative to the school's two hot meals. This would replace salads due to limited availability of fresh produce during the winter. A meatball ciabatta sandwich was approved by the cafeteria manager for student evaluation. A total of thirteen fifth graders, age nine to eleven, evaluated the meatball ciabatta sandwich. The evaluation used was based on a 5-point hedonic scale that rated the meatball ciabatta sandwich on looks, taste and smell. The majority liked the sandwich but thought alterations were needed to improve on the taste. The nutrition analysis was within the nutrition standards for school meals guidelines, and the cost of the recipe fit within the school's lunch budget. Therefore, the sandwich was considered a good option once the alterations are made for taste and presentation.

## Textiles: Weaving

Melody Barker, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor) Human Sciences

For my final project, I made a scarf using the Ashford Fixed Heddle Loom. This is interesting to me because weaving has been around for hundreds of years, it only makes sense to understand how our clothes were first made. Setting up the loom and interlacing the thread takes some time before starting the actual weaving process. My hypothesis for this project is that even though the loom is simple, the end results are intricate and can reflect an individual or culture as a whole.

For my scarf, I watched videos and tutorials as an example for what I will be doing. I noticed it takes a considerable amount of time to weave each thread through. Even setting up the loom took some time. I used two 100% acrylic yarns found at JoAnn's Fabrics. Since I'm a beginner, I decided to do a simple checkered pattern. I worked on the scarf three different days. It took 5 hours total for me to complete the scarf. Of course there were some uneven threads at the beginning but eventually I got the hang of it. I was surprised how beautiful the end results were. It was definitely worth the time. Also, take in consideration it cost to make the scarf which was about \$5 for the thread while in store it would be around \$20.

This project sparked my curiosity for learning more unique ways to make garments. I recommend everyone trying the Ashford Fixed Heddle Loom. It's so easy to use and you can create so many things. I am hoping to experiment more with different types of looms and patterns for bigger and more complex designs.

### Robotic Arm Manipulator for Classroom Aid

Christopher Secrest, Undergraduate student, Engineering Technology; Bradley Hobbs, Undergraduate student, Engineering Technology; Brian Slaboch (Faculty sponsor) Engineering Technology

Any beginner engineering student can attest to the argument that more tangible examples would aid in theory comprehension. This research aims to produce a mechanism that will serve as a lab/lecture aid for theoretical engineering courses at MTSU. The goal is to design and construct a robotic arm that can be programmed to exemplify the equations of motion studied in statics, dynamics, kinematics, and controls courses offered within the Mechatronics program at MTSU. The arm features three degrees of freedom and a claw. A live demo that exemplifies the range of motion and versatility of the mechanism will be given. This semester's project focused on the upper level design, whereas future teams will work to program this device to apply it to specific classes and lectures.

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

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

*Cryptococcus neoformans* (*Cn*) is a ubiquitous encapsulated yeast, typically found in soil and bird feces. This fungus is pathogenic and can cause disease in immunocompromised individuals and is responsible for death in over 600,000 people 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 larger and less branched molecules have been shown to not activate the immune response, which would ultimately lead to increased virulence in males versus females. To test this, 28 strains of *Cn* were isolated from HIV+ patients in Botswana (12-16-). Each strain was grown in capsule inducing media, then ultrafiltered to extract GXM from media. Dynamic light scattering was performed on each sample and differences in size distributions were analyzed. We expected to see a significant difference in the hydrodynamic radius of GXM extracted from male clinical isolates versus female clinical isolates. Preliminary data on capsules from 10 strains agrees with our hypothesis and suggests that capsules from strains isolated from males have larger molecules of GXM, possibly explaining why the incidence of disease caused by *Cn* is so much higher in males.

## Yep!!! Alcohol Might be Costing You Sleep: Alcohol Abuse and Sleep Deprivation Among High School Student in the United States

Simale Abadula, Undergraduate student, Health and Human Performance; Andrew Owusu Ph.D., Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Purpose:** According to the American Academy of Sleep Medicine (AASM) teenagers need between 8 and 10 hours of sleep each day. Many factors may contribute to the lack of enough sleep among teenagers. This study examined the relationship between sleep and alcohol abuse among high school students in the United States.

**Methods:** Data for this study was retrieved from the self-administered 2015 Youth Risk Behavior Survey conducted by the US Centers for Disease Control and Prevention (CDC). The independent variables were: students who drank at least once in the past 30 days, students who drank at least 5 in a row within a few hours (binge drinkers) in last 30 days, and students who reported that they had 10 or more drinks in a row within a few hours (super-binge drinkers) in last 30 days. The dependent variable was a question about getting 8 hours or more of sleep each day in the past 30 days. Prevalence estimates and odds ratios were computed for 2 X 2 complex sample tables.

**Results:** Overall, 44.5% of United States students report drinking alcohol in the 30 days before the survey. Only 30.4% report getting 8 or more hours of sleep each day. Students who consumed alcohol in the 30 days before the survey were significantly less likely to sleep 8 or more hours each day (OR=.62 [0.59-0.66]); Binge drinkers and super-binge drinkers were also less likely to get 8 hours of sleep; OR=0.62 [0.58-0.65] and OR=0.64 [0.53-0.77] respectively.

**Conclusions:** The significant relationship between alcohol use (current and binge drinking) indicates a need for sleep programs designed for teenagers to explore the possible role of substance use such as alcohol.

Effects of Oxidative Stress in Intestines of *Caenorhabditis elegans*

Saraf Chowdhury, Undergraduate student, Biology; Lynn Boyd (Faculty sponsor) Biology

Stress is a major phenomenon present in lives of all organisms in the planet. Organisms respond differently to various kinds of stress. Common types of stress experienced during a lifetime are salt, heat, or oxidative stress. This experiment attempts to discover the ubiquitin stress response in the intestines of *Caenorhabditis elegans* under oxidative stress. They are used to study stress because proteins that respond to stress such as ubiquitin are highly conserved. Ubiquitin in *C. elegans* and ubiquitin in humans differ only by one amino acid which makes them 98.68% genetically identical. Therefore, carefully studying the ubiquitin response in *C. elegans* gives us a good understanding of the way it works in humans as well. ERT 261 and ERT 264 (intestinal strains) one day adult *Caenorhabditis elegans* were treated with hydrogen peroxide for oxidative stress, NaCl for salt stress (positive control), and M9 buffer for an unstressed condition (negative control). In this experiment, foci (spheres) were observed in the intestinal tissue under oxidative stress. In addition to whether or not nuclear spheres formed in the intestine, this experiment used different concentrations of hydrogen peroxide to cause different levels of oxidative stress and thus a relationship between the level of oxidative stress and the percentage of nuclei with spheres observed was developed. At 5mM, 50% of the ERT 261 had nuclear spheres, while at 10mM and 15mM it was 44% and 58%. To take the experiment another step further, a recovery period for up to 24 hours was allowed and the percentage of nuclei with foci were observed. A decrease by 9% in M9, 25% in 500mM sodium chloride, 42% in 5mM, 36% in 10mM, and 42% in 15mM of hydrogen peroxide was observed after the 12-hour recovery period, when compared to those after 1 hour of stressing.

## Love, Death, and the Single Story

Emily Cothren, Undergraduate student, English; Jessica Green, Undergraduate student, Liberal Studies; Lesley Sweeton, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

In her 2009 TED Talk, Nigerian writer Chimamanda Ngozi Adichie draws attention to the challenges of being a black woman writer. She characterizes one of these challenges as the danger of a "single story," a danger to which the writings of Zora Neale Hurston and Shonda Rhimes both fall prey. Loved, lost, and eventually rediscovered by Alice Walker, Hurston's *Their Eyes Were Watching God* (1937) is a novel that addresses a wide range of emotions and cultural customs while providing searing social commentary. Literary critic Henry Louis Gates nonetheless argues that Hurston's writing focuses mainly on the timeless themes of love and death. Critics relegate Shonda Rhimes - creator, writer, and producer of such TV shows as *Grey's Anatomy* and *Scandal* - to the same limited space. Our project compares Hurston and Rhimes in order to debunk the idea that the two women write only about love and death. While our primary research method will be literary analysis of primary sources, we will also consult biographical material on Hurston and Rhimes, including some sources commenting on Rhimes's reaction to being labeled "an angry black woman." The audience for our project includes anyone interested in Hurston, Rhimes, black women writers, or literature.



Effects of Gallium Protoporphyrin IX on *Acinetobacter baumannii* Catalase

Kyra Boots, Undergraduate student, Biology; Brock Arivett, Graduate student, Biology; Anthony Farone (Faculty sponsor) Biology

Each year almost two million people in the United States suffer from hospital acquired infections, which result in about 99,000 deaths. The CDC conducted an investigation of two hospitals in Baltimore, Maryland that found eighty percent of the reported infections were caused by *Acinetobacter*, which is known to cause urinary tract infections in patients who have catheters and pneumonia in patients on ventilators. The antimicrobial properties of Gallium Protoporphyrin IX (Ga-PPIX) may be used as a new therapy for *Acinetobacter* infections since the bacteria is resistant to almost all antibiotics. Patients affected by *Acinetobacter* would benefit greatly from a new, effective method of treatment. The goal of this project is to determine the effect Ga-PPIX has on the catalase of *A. baumannii*. The two *Acinetobacter baumannii* strains, 19606T and ACICU, will be grown under aerobic conditions. Enzyme assays for catalase activity will be measured using a microtiter assay. After enzyme purification by column chromatography, the subunit weight of the purified catalase will be tested by electrospray ionization mass spectrometry. The gallium and iron bound to the purified catalase will be measured in order to show if the enzyme activity was decreased. It is expected that Ga-PPIX will be incorporated into catalase and reduce catalase activity.

## Why Do Some Countries in Africa Have Stronger Education Systems than Others?

Brittney Johnson, Undergraduate student, Political Science; David Carleton (Faculty sponsor)  
Political Science

From climate to culture, countries in Africa vary drastically in almost every measure possible, and the contrast between education systems is no exception. While some African countries seem to be thriving, other countries in landlocked, sub-Saharan Africa are struggling to get their footing and most have faltering economies and crumbling infrastructure. At the root of these problems seems to be a lack of adequate education available to the average citizen. In my research, I examined four countries and attempted to draw conclusions as to why countries like Botswana and South Africa have a stronger education system than countries like South Sudan and Niger.

In order to measure how strong an education system is I examined the literacy rate, the percentage of government spending that is allotted to education, and the percentage of children completing primary education. I also studied what effects the state of the economy, the type of government, the varying amount of money spent on education, and the presence of domestic conflict have on each country's education system and compared them.

### Polysaccharide Profiles in Callus Tissue of American Ginseng (*Panax quinquefolius*)

Evidence Nwangwa, Undergraduate student, Chemistry; Rajarshi Ghosh, Graduate student, Chemistry; John DuBois (Faculty sponsor) Biology

American Ginseng (*Panax quinquefolius*) root has traditional medicinal purposes, such as treating nervousness, vomiting, dyspepsia, asthma, and stress. These medicinal effects are due to ginsenosides and polysaccharides. Recent studies show ginseng polysaccharides exhibit antitumor, immunomodulatory, and antioxidant activities. The active compounds of ginseng root accumulate over time and hence the plant is harvested typically after five to seven years. Ginseng industry and researchers are hoping to use callus tissue to produce large quantities of medicinal polysaccharides, since large quantities of callus can be produced in a very short time. The purpose of this study was to assess the polysaccharide profiles in ginseng callus tissue and compare them to profiles in ginseng roots. The polysaccharide profiles of ginseng callus were determined through an extraction and a chromatographic purification process. Crude polysaccharide solutions were fractionated using a sequential process of anion exchange and size-exclusion chromatography that used different concentrations of NaCl. Resulting fractions were subjected to dialysis and analyzed using High-Performance Liquid Chromatography (HPLC) for purity and to determine molecular weight. The anion exchange profiles of each fraction from the ginseng callus are similar to the plant anion exchange profiles. In addition, the size exclusion profiles of each fraction obtained from ginseng callus are similar to the plant size exclusion profiles.

Ecocriticism: An Allegorical Interpretation of the Environmentalism Movement in *Godzilla*

Cassidy Johnson, Undergraduate student, Recording Industry; Joan McRae (Faculty sponsor)  
Foreign Languages and Literatures

Over the course of the history of humanity, people have consistently displayed their selfishness, ignorance, and nonchalant attitudes about environmental destruction in a variety of situations and settings, ourselves in the modern world included. Even in a world of fantasy, we are forced to come to terms with the difficult topic of our own human nature. Though the first *Godzilla* movie was released in 1954, it would bring up the tough questions of our relationship with the environment that would quickly come to the forefront of Americans' attention in 1962, when Rachel Carson sparked the modern environmentalism movement with the release of her book *Silent Spring*. The topic I would like to discuss through this project is how *Godzilla* illustrates textually in fictional form the environmental concerns of Rachel Carson, to be disseminated to a very broad and diverse audience. Though this project would be of special interest to cinematic, literary, and environmental scholars, the intended audience is broad. I have evaluated the film under the concept of Ecocriticism, a developing branch of literary criticism, which I have adapted to address a cinematic work.

## RNA-Seq Analysis of Clinical *Cryptococcus neoformans*: Host-pathogen interaction in male and female human patients

Basant Salem, Undergraduate student, Biology; Erin McClelland, Faculty, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

*Cryptococcus neoformans* is a pathogenic yeast that is the leading cause of fungal meningitis in patients who are unable to develop a normal immune response due to immunosuppressive therapy that they are undergoing, or in other words, are immunocompromised. It typically kills over 600,000 of these patients annually. Therefore, we constructed a research experiment to help us better understand the cause of the disease. Prevalence of disease between males and females is distinct, with females being more resilient to the disease. The different gender environments in males and females cause the *Cryptococcus neoformans* to react differently because of this factor. Our objective was to isolate RNA from clinical strains, collected from patients who have both survived and died of the disease, sequence the RNA, and analyze/compare the possible patterns of gene expression in males and females, in order to identify genes that may be involved in making the pathogen virulent. We initially collected seven *C. neoformans* strains from Botswana AIDS patients, in addition to one wild-type control strain. We grew cells from all eight strains. We then isolated the RNA of each strain and removed the contaminated DNA. After obtaining the clean RNA samples from all eight strains (3 replicates each), cDNA libraries were created using NEBNext Ultra RNA library Prep Kit for illumina HiSeq sequencing. Results of RNA-seq analyses, revealing differentially expressed genes of strains collected from males versus females, will be presented.

## Noise Reduction of Unmanned Aircraft Propellers by Utilizing Barn Owl Biomimicry

Braxton Harter, Undergraduate student, Aerospace; Emma Gist, Undergraduate student, Aerospace; Nate Callender (Faculty sponsor) Aerospace

The aviation industry has been experiencing rapid growth in the Unmanned Aerial Systems (UAS) market. This growth has been checked by Federal Aviation Regulation (FAR) Part 107 that mandates UAS to be operated below 400 feet, or within 400 feet of any structure. This law creates a high concentration of UAS near the ground, which concentrates their noise in the vicinity of the public, which may cause a noise disturbance. The propellers on the UAS are the largest source of their noise. They can be modified to create less noise without reducing thrust to an unacceptable amount. Barn owls are noted for their stealthy flight because of their unique characteristics: the addition of feathers in the form of a leading-edge comb; a fringe formed by the feathers at the trailing edge; and a velvet-like covering on the wing upper surface. With the use of biomimicry, these characteristics can be applied to UAS propellers to reduce sound pressure levels (SPL). The purpose of this study is to analyze and optimize the effects of applying an upper surface to UAS propellers. The modifications applied to propellers adds minimal mass, reducing sound without adversely affecting lift. Several upper surfaces are being tested on their ability to reduce SPL. Initial upper surface studies have achieved up to a 5 dBA reduction in SPL while maintaining thrust. By improving these designs, more efficient propellers can be created to achieve quieter UAS.

## Acceptance of Homosexuality Across Countries and Demographics

Madeline Vowell, Undergraduate student, Political Science; David Carleton (Faculty sponsor)  
Political Science

I was curious before I started this project about why some countries were so staunchly against homosexuality and why others were not. It became my mission to examine in this poster the reasons why some people in some countries found it easier to disapprove of others because of sexual orientation. In this poster I looked at the demographics of people in some countries, to determine if they had any effect on acceptance overall.

The different demographics I looked at within the country were the percentages of the population who were religious, female, and over 55. I also looked at the average years of schooling in each country.

I thought that the percentage of people in a country who consider themselves religious will have a negative effect on the number of people who believe that homosexuality is always wrong. I thought that the number of people over the age of 55 will affect the percentage of people who disapprove negatively, the more over the age of 55, the more people will disapprove. I thought that the more educated people are, the more schooling they received, the more accepting of homosexuality they are, therefore the more educated the country, the lower the disapproval rate. I thought that the higher the percentage of females, the lower the number of people who disapprove will be.

## The Relationship Between Bullying, Depression and Suicidal Tendencies Among High School Students in Tennessee

Teara Pryor, Undergraduate student, Health and Human Performance; Haley Greene, Undergraduate student, Health and Human Performance; Andrew Owusu, Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Purpose:** According to *The Tennessean*, the state of Tennessee ranks 6th worst for bullying of school students. Past studies have found that bullying is linked to an increased chance of mental health problems among victims. This study examines the relationship between bullying, signs and symptoms of depression and suicidal tendencies among Tennessee high school students.

**Methods:** Data from the *2013 Youth Risk Behavior Survey* was analyzed to examine the relationship between the independent and dependent variables. The independent variable selected was bullying. The dependent variables were: signs and symptoms of depression, suicidal thoughts' and suicide attempt. Complex samples frequencies and tables were calculated; odds ratios were also calculated for 2X2 cross-tabulations.

**Results:** Overall, 21.1% of students reported being victims of bullying. Females are OR=1.592 times more likely to experience bullying than males. 28.3%, 15.2% and 9% reported depression symptoms, suicidal thoughts, and suicide attempt respectively. Students who reported being victims of bullying were significantly more likely to report symptoms of depression (OR= 4.008 [3.94-4.073]), suicidal thoughts, (OR= 4.618 [ 3.17-6.734]), and attempted suicide, (OR=4.573 [2.71-7.709]).

**Conclusion:** Programs focusing on bullying among Tennessee high school students should also consider paying attention to possible signs of depression and suicidal tendencies among bullying victims. However, because this study focuses on reported behavior at a single point in time, it is suggested that future studies look into cause and effect links among bullying victims.



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 (*snf3* $\Delta$ ) 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 and are currently working on the neomycin resistance marker. 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.

## A Nonaggressive Ethical Analysis of Reparations for Slavery in America

Christopher Cowherd, Undergraduate student, Political Science; Patrick Richey (Faculty sponsor) Communication Studies and Organizational Communication

This presentation will address the cultural and political discussion surrounding social reparations for slavery in America. The catalyst for this work is the lack of a clear standard or test within the academic and popular conversation on reparation theories to determine whether or not social reparations are ethically acceptable as enforceable law. The intended audience for this paper is academic and popular, aimed at those with a scholarly interest in race theory, libertarian ethics or American Jurisprudence, as well as those with a more social focus on race relations and justice in America today.

The analysis I wish to conduct begs two important questions. First what is non-aggressive ethics? Second what are social reparations for slavery?

Nonaggressive ethics are rooted in the “nonaggression principle,” which generally states that no one may threaten or commit violence against another man's person or property. My first point of analysis will create an equitable definition of what nonaggressive ethics actually means.

To define social reparations, I will not focus on specific demands for reparations, but rather on a single unifying principle of reparation theory: some form of valuable compensation for the ethical violations committed against slaves in the United States. Additionally, I will broadly categorize reparations as being administered voluntarily or involuntarily.

My analysis will consist of several parts. First I will discuss whether or not slavery is in fact a violation of the nonaggression principle. Second, I will establish a non-aggression based methodology to equitably administer justice to victims of crimes like slavery. Third, I will compare the general principle of social reparation with the nonaggression principle, and see if the two can exist in the same world. Fourth, I will analyze the underlying philosophical differences between the two (collectivism versus individualism) and explain why they are philosophically incompatible.

## Computation and Modeling of Regime-Switching Equity-Linked Insurance Contracts

Haocheng Wu, Undergraduate student, Mathematics; Zhangyao Chen, Undergraduate student, Mathematics; Abdul Khaliq (Faculty sponsor) Mathematics

Equity-linked life insurance is a kind of insurance and investment with high flexibility and high yield. This special characteristic renders insurance company difficult to control risk. As a result, the risk management of policyholder behavior in equity-linked life insurance has been discussed by scholars for a long time and they tried to address the problem in various methods. We study the papers “Risk Management of Policyholder Behavior in Equity-Linked Life Insurance” [1] and “A Regime-Switching Model of Long-Term Stock Returns” [2] by Hardy and derive a regime-switching equity-linked insurance model. The equity-linked insurance model is based on both geometric Brownian motion and human mortality model. The Black-Scholes partial differential equation (PDE) is evolved in the equity-linked insurance model and is solved using finite difference approximation. PDE embedded by variable parameters is worked out by numerical solutions of nonlinear systems. All of the programming in the process to establish the model is done by “R” language. We use the regime-switching Markov chain and try to adopt the model based on geometric Brownian motion. The regime switching model usages a transition matrix, which allows the pricing model to switch among several situations and leads the whole pricing model to fit the extreme changes of the equity’s fluctuation in the real world. Parameters in this model are estimated via maximum likelihood estimation. Eventually, a regime-switching model of equity-linked insurance is derived.

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### Voice-Activated Robotic Arm

Meranda Jacobs, Undergraduate student, Engineering Technology; Chong Chen (Faculty sponsor) Engineering Technology

There are members of society lacking control over sections of their physical bodies. A commonly seen ailment is loss of ability to control one's arms. For some people, their arms, or an arm, are completely paralyzed, or missing, which encompasses the absence of ability to perform all motor functions requiring the use of the elbow, wrist, hand, fingers, and/or activities utilizing the entire arm. For other people, the control they do maintain over their upper limbs is not significant to adequately control movement which might accomplish meaningful tasks. The particular problem this project will focus on, within the previously described realm of human incapacity, is the lack of ability to perform a series of events allowing one to successfully attain a drink.

To utilize assistive technology, in the form of a voice-activated robotic arm, which can ease the burden of day-to-day living for those with such conditions as defined in the catalyst/audience statement by allowing said people to drink when a beverage is desired.

We are currently building the robotic arm with lengths of lightweight, rigid material, harboring high-torque servos between selected joints, which has a cup holding, plastic ring adhered to one end, and a metal base with an adjustable height strap at the other end. A programmed microcontroller, and all other electrical components involved in necessary operation of the device, will be housed in a small, transferable box with the ability to be placed in a location convenient to the user.

The device will be powered through a wired connection from the microcontroller to a smart outlet plug delivering the required 9V. The smart outlet plug will be voice activated to power on, or off, via Bluetooth, or Wi-Fi, connection to Amazon's Echo Dot device utilizing virtual assistant Alexa.

## A Mental Health Issue: The Relationship Between Sexual Assault and Mental Health Among Tennessee High School Students

Haley Greene, Undergraduate student, Health and Human Performance; Teara Pryor, Undergraduate student, Health and Human Performance; Dr. Andrew Owusu, Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Purpose:** Existing studies indicate that sexual assault can have significant damaging outcomes on victims' mental health including PTSD symptoms. According to NSVRC.gov, 1 in 4 girls and 1 in 6 boys will be sexually abused, including assault, by 18 years of age. Few studies have examined sexual assault among youth in Tennessee. This study examines the relationship between sexual assault and mental health among high school students in Tennessee.

**Methods:** Data for this study was retrieved from the self-administered 2013 Tennessee Youth Risk Behavior Survey. The independent variable was a question about sexual assault experience. The dependent variables were; signs of depression, suicide ideation, suicide planning, and suicide attempt. Prevalence estimates and odds ratios were computed for 2 X 2 cross-tabulations.

**Results:** Overall, 10.39% of students report ever being sexually assaulted. Female students were significantly more likely to report sexual assault 2.3 [1.8-2.9]. Students who had experienced sexual assault were significantly more likely to report signs of depression (OR=4.26 [2.73-6.65]); suicide ideation (OR=4.67 [3.23-6.76]), suicide planning (OR=5.51 [3.38-8.97]), and suicide attempt (OR=6.91 [6.21-7.69]).

**Conclusions:** The significant relationship between sexual assault and depression, suicide ideation, suicide planning, and suicide attempt indicates a need for more comprehensive studies to better understand the links and possible protective factors. Program planners need to recognize the importance of also addressing mental health when working with sexual assault victims.

For Colored Girls Who Have Considered Revolution: Ntozake Shange & Haiti

Kieth Cripps, Undergraduate student, Recording Industry; Laura Dubek (Faculty sponsor)  
English

First performed in 1976, Ntozake Shange's *For Colored Girls Who Have Considered Suicide / When the Rainbow is Enuf* won an Obie Award and in 2010 was made into a major motion picture. The choreopoem encapsulates the experience of African American women through its use of multiple perspectives and confessional poetry. My project explores the suppression and empowerment of black women by examining Haitian revolutionary Toussaint L'Ouverture's presence in the ninth poem of Shange's masterpiece: "*toussaint*." Through literary analysis and historical research, my project seeks to draw parallels between the situation leading to Haiti's insurrection against slavery and colonialism at the turn of the nineteenth century and that of the United States during the mid-twentieth century. My primary sources include Ntozake Shange's *For Colored Girls*, scholars' analyses of Shange's text, and articles about Toussaint L'Ouverture and the Haitian Revolution. My audience is anyone with interest in the topics of black women's literature, oppression based on race and/or sex, or the Haitian Revolution.

### 3D Printing in Fashion

Levy Eskind, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor) Human Sciences

Recently, there has been a lot of talk about 3D printing, especially in fashion. Designers have been taking on 3D printing as a new way to create fresh, new looks and styles on the runway. This technology has brought fashion to a new level.

I first researched 3D printing used by fashion designers. Designers were making full garments with 3D printing and it was unreal. MTSU has multiple 3D printers and I got to go and learn about them. I was taught how to use the 3D filament printer. This allows you print things in a plastic material. First, you pick out which design you want to print, I chose a coffee mug. Next, you make it the size and color that you want. You load the filament on to the printer and set the temperature of the printer. It is important that the printer is at the right temperature so that the printer performs correctly. Once the printer is heated, you can start the printing process. This can take multiple hours depending on the size of the design. My coffee mug took an hour.

I wanted to design something myself to print. After hours of attempting to use the software to design my own object, I had no luck. I know that if I had been able to learn how to use the design software, I would have been able to make something like a shoe or even an actual garment.

This project taught me a lot about the different ways that we see fashion. There are now technologies to where there is no sewing needed at all and it can all be done on the computer. I look forward to having more time to work with the 3D printers and make a real garment with them.

## Effect of Rapamycin Treatment on Chronological Lifespan of Wildtype and PUT1 Mutant Budding Yeast

Anas Hajhusein, Undergraduate student, Chemistry; Madeline McDonald, Undergraduate student, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

PUT1 has been implicated in reduced aging via a more efficient method of recycling proteins. PUT1 gene expression is induced by growth in proline-based medium and also treatment with the drug, rapamycin. This suggests that when rapamycin is present, wildtype yeast will have an increased lifespan. In addition, put1 mutant yeast should be insensitive to the increased lifespan effect of rapamycin. To test this hypothesis, wildtype and mutant yeast were treated with rapamycin or water and then aged from 1-6 weeks. After the aging period, the ability to grow (chronological lifespan) was measured as the change in optical density from 0 hours and 24 hours at room temperature. The student's t-test was employed to determine statistically different results. Lifespan for wildtype and mutant yeast were very similar for all six weeks. Drug treatment causes lifespan in both strains to be reduced, particularly in weeks 1-3. However, lifespan may have begun to recover around week 4 for both strains treated with the drug. These results, therefore, contradict what was predicted based on the literature. Replication of the experiment with a range of rapamycin doses and in a low proline medium would be interesting next steps.



## Characterizing the Interactions of MtbClpC1 and ATP through Single Turnover Kinetic Experiments in Stopped Flow Spectrophotometer

Justin Marsee, Undergraduate student, Chemistry; Justin Miller (Faculty sponsor) Chemistry

Bacterial pathogens such as *Mycobacterium tuberculosis* (*Mtb*), have no known cure, but can be successfully treated with powerful antibiotics like rifampicin. However, the past decade has seen a rise in drug resistance, specifically MDR-TB (Multi-Drug resistant tuberculosis) along with XDR-TB (Extensively-Drug resistant tuberculosis). While tuberculosis is relatively rare in the United States, these drug-resistant strains could change that by rendering our only defense against the bacteria ineffective. It is because of this growing threat of mutated antibiotic resistance of *Mtb* (and other pathogens) that there is a grave need for the study and development of additional treatment pathways. Out of this need, there have surfaced new potential drug targets in molecular complexes like ClpC1P. The ClpC1P complex performs one function: catalyzing regulated proteolysis. Regulated proteolysis is the act of degrading a select few peptides that encompass a great many functions to ultimately regulate a vast amount of other essential proteins in the cell. Within this complex are two subunits: ClpC1 and ClpP; the ClpC1 subunit is a molecular motor, that, when stimulated or inhibited, could result in the inactivity of *Mtb*. The answer to the emerging issue of antibiotic resistance, could lie in the hydrolysis of ATP by ClpC1 as it translocates a peptide. Work in the lab is ongoing to determine the specifics of these interactions of ClpC1 and the conditions they must occur under. Ultimately, the goal of this study is to determine the role of ATP in substrate unfolding at the molecular level.

### Walking Into Purple: Examining Sexuality in African American Literature

Alison Trammell, Undergraduate student, English; Kayla Bartlett, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

Alice Walker's *The Color Purple* has stood the test of time. The novel garnered two awards in 1983: the National Book Award and the Pulitzer Prize. It is not only a prize-winning work of fiction, but has also been reimagined as a movie in 1985 and a musical in 2005 that was later revived in 2015. A poet, novelist, and social activist, Walker came out as bisexual in 1996. Her announcement prompted renewed interest in her work, especially with regard to its representations of sexuality. In *The Color Purple*, Walker creates characters that challenge conventional ideas about love and sex. The purpose of our research is to compare her exploration of sexuality to other African American literary works in order to highlight a tradition of black writing on LGBTQ issues – something we tend to associate with primarily Caucasian and/or comic relief characters. While our primary source is Walker's novel, we will also consult biographical materials, reviews, and scholarly essays that establish sexuality as a central theme in black literary tradition. Our audience includes those seeking a greater understanding of sexuality and/or an appreciation of African American literature.

## Why Do More People Use Public Transportation in Western European Cities than in North American Cities?

Tess Shelton, Undergraduate student, Political Science; David Carleton (Faculty sponsor)  
Political Science

As the title indicates, this project addresses possible explanations as to why more people use public transportation in Western European cities than in North American cities. My research compares the use of public transportation by region in three cases of cities with similar population sizes: New York versus London, Los Angeles versus Berlin, and Toronto versus Rome. I measure public transportation use by the number of people who use public transportation per capita based on data provided from the cities' public transit websites. Three hypotheses are tested for each of the cases. The first hypothesis is that the lower public transit fares are, the more people use public transportation; the second is that the higher fuel taxes are, the more people use public transportation; and the third is that the more accessible public transportation is, the more people use it. Because there is currently no standard metric for accessibility, I measure accessibility based on how many railway stops and buses are in a city. Those two factors represent the number of locations from which people can access public transportation and the frequency with which public transportation can be accessed, respectively. Examining these hypotheses can provide insight into what government officials and urban planners can do to encourage more people to use public transportation. Encouraging more of its city-dwelling population to use public transportation is one way that a country can reduce its carbon footprint. Moreover, increasing its public transit ridership could bolster a city's reputation, helping attract new residents to stimulate its economy.

## Learning to Weave

Meghan Routh, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor) Human Sciences

I have researched and learned how to create woven products on a rigid heddle loom with plain weave. I learned the brief history of the loom and how it has advanced to what is used in factories today. I next used an online class on Craftsy.com to learn the basics of weaving on a loom I was able to borrow from the Textiles Lab in the LRC. I used a plain weave (the simplest) to construct two scarves. One was for practice and learning. The other was to express creativity. I created a plaid design on the second with a twisted fringe on the ends. I hope to express my newfound love for weaving as well as how it has propelled me in my education regarding apparel manufacturing by providing insight into the processes of weaving. I am now able to look at garments and know how their fabric was constructed.

### Late Stripped $H0^*$ Trajectories in the Spallation Neutron Source Injection Region

Josie Lyon, Undergraduate student, Physics and Astronomy; Nicholas Evans (Faculty sponsor)  
Oak Ridge National Laboratory, Research Accelerator Division

The Spallation Neutron Source (SNS) generates neutrons by accelerating  $H^-$  ions to 87% the speed of light, injecting these ions into the SNS accumulator ring, and then ejecting an intense proton beam to a mercury target. The dominant limitation for operating accelerators at high power is beam loss, and the highest SNS losses occur near the ring injection region. About 3% of the injected ion beam becomes neutral hydrogen, some of which is in an excited state ( $H0^*$ ) that can be later stripped of its loosely bound electron and cause beam loss. The trajectories of late stripped  $H0^*$  loss are unknown. We tracked late stripped  $H0^*$  trajectories in a G4Beamline simulation of the injection region. Our model showed 100% loss for particles stripped 7cm past the primary foil, with beam loss concentrated between the first ring quadrupoles and the vacuum vessel fork between the injection dump and the ring.

### Measuring Endogenous DNA Damage in *Daphnia* Using the Comet Assay

Laura Warren, Undergraduate student, Biology; Melissa Pompilius, Graduate student, Biology; Robert Fischer, Faculty, College of Basic and Applied Sciences; Robert Fischer (Faculty sponsor) College of Basic and Applied Sciences

Damage to somatic tissues may take many forms, but DNA damage in particular has been shown to have negative effects on many physiological processes, and has been proposed to be an underlying cause of aging. Our lab is presently investigating the accumulation of DNA damage over the lifespan of the cladoceran *Daphnia* using the Comet assay to measure DNA strand breaks. While this technique is commonly used to measure DNA damage induced by noxious chemicals or UV irradiation, we are testing its suitability for measuring endogenous DNA damage that results from the aging process alone. The assay is based on embedding isolated animal cells in an agarose gel, and lysing them to release tightly coiled DNA nucleoids, which appear as “comets” on gels stained with a fluorescent dye. Applying an electric field causes DNA with strand breaks to migrate away from the nucleoid, producing a “tail” characteristic of damaged strands. The proportion of DNA in the tail thus provides a sensitive measure of DNA damage. In this study, we compared two different methods for generating DNA nucleoids from individual and pooled *Daphnia* or their eggs: 1) isolating the total cells from animals or eggs homogenized with glass beads (HM), versus 2) isolating only hemolymph cells by a single pulse with glass beads (SP). Both methods were sufficient for generating cells suitable for electrophoresis. However, nucleoids generated by the HM method were difficult to distinguish, due either to the heterogeneous cell population or contaminating tissue fragments. The SP method was superior, producing identifiable nucleoids from hemolymph cells generated from individual or pooled animals, as well as from individual eggs. Testing the sensitivity of the Comet assay for detecting DNA damage in aged tissues is presently underway.

## Tolerance of Gay-Straight Alliances in Public Schools: LGBT Adolescents' Struggle for Support and Coexistence

Robin Stone, Undergraduate student, Social Work; Justin Bucchio (Faculty sponsor) Social Work

Discrimination against Lesbian, Gay, Bisexual, and Transgender (LGBT) people in the United States is prevalent throughout the country's history. A commonly recognized support organization for LGBT individuals, primarily adolescents, is the Gay-Straight Alliance (GSA), which is an extracurricular student organization in public schools that provides a supportive zone for these adolescents to unite with heterosexual allies away from an atmosphere that is otherwise occupied by homophobia and bullying. In 2016, Franklin County High School, in rural Tennessee, established its first GSA with much unanticipated resistance. This study evaluates community members' support and opposition of the club as they were expressed through semi-structured interviews, identified through snow-ball sampling. Guided by the standards set by the Code of Ethics of the National Association of Social Workers, this study aims to understand the diversity and oppression of non-heterosexuals with a goal to prevent discrimination towards non-heterosexuals. These goals are attained through the collection of data concerning the rationale behind prominent ideology of individuals in this area known as "the Bible Belt." This qualitative research can be used to identify methods and ideas that have the potential to make public high schools, like Franklin County High School, a safe place for all students – regardless of sexual orientation.

### Why Do Some European Countries Experience More Terrorism than Others?

Beatriz Marie Dedicatoria, Undergraduate student, Political Science; David Carleton (Faculty sponsor) Political Science

This research project focuses on terrorism. It analyzes why some European countries experience more terrorism than other European countries. To do this, six countries from two regions in Europe, West and East Central, were chosen and studied as cases. They are Poland, Czech Republic, Slovakia, UK, France, and Germany. Poland, Czech Republic, and Slovakia belong to East Central Europe where the level of terrorism is fairly low. On the other hand, UK, France, and Germany belong to Western Europe where the level of terrorism is relatively high. In addition, this research project discusses four different independent variables-Muslim population, urban population, political stability, and wealth-and the role they play with regards to terrorism. Several resources such as *The Global Terrorism Index*, *Political Stability Index*, and *The World Factbook* are used to measure these variables. This research project also examines the results and what can be concluded by looking at different statistics and data provided.



Promoting Global Understanding: An In-Depth study of the Neo-Classical Frescoes located at Villa Di Geggiano, Siena Italy

Joy Shind, Undergraduate student, Art; Debrah Sickler-Voigt (Faculty sponsor) Art

As a future art educator, my goal is to present meaningful art lessons that introduce students to international cultures while reflecting on historical art making processes. I have decided to use the art that inspired me during two separate study abroad trips to Italy to create a lesson plan based on the study of frescoes. I focused specifically on the frescos located at Villa Di Geggiano in Siena, Italy. To enhance my lesson, I have created my own fresco using historical techniques. I also wrote an extensive literature review on the history of frescos.

The literary review highlights important advances in technical skills and cultural trends of historical fresco making. A complete analysis of the history of frescos enabled me to understand the significance of the frescos located at Villa Di Geggiano. I hope to inspire my future students by relating the research I have done to their studies and enhance global understanding.

Using my research in historical techniques, I have created a lesson plan that provides strategies for teaching fresco techniques to K-12 students. As a URECA Gold level grant winner, I am excited to share my finding with fellow Middle Tennessee State University students and faculty through presenting a detailed poster of the work I have completed.

## Effects of Predator Kairomones and Starvation on *Tegula tridentata* Behavior in a Chilean Subtidal Ecosystem

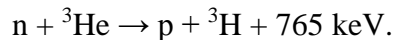
Brooke Fitzwater, Undergraduate student, Biology; Dennis Mullen (Faculty sponsor) Biology

Gastropods have been shown to alter their behavior in response to both predators and starvation. *Tegula tridentata*, a marine subtidal gastropod in Chile, is an herbivore that is preyed upon by the crab *Homalaspis plana* and the sea star *Meyenaster gelatinosus*. The effects of kairomones (chemicals) from *H. plana*, *M. gelatinosus*, and crushed conspecifics as well as the effects of starvation were tested to see if the different treatments elicited behavioral responses by *T. tridentata*. Three experimental trials were conducted in which *T. tridentata* behavior was monitored continuously every hour for 24 hours and was then monitored at less continuous but regular intervals for up to 72 hours. Aquaria containing *T. tridentata* (one per aquarium) were connected to predator treatment aquaria via flow-through systems to allow for kairomones to flow from the treatment aquaria into the *T. tridentata* aquaria. Different starvation levels were also used alongside the presence of kairomones. *T. tridentata* behavior and location within the aquarium was recorded during each observation. There was a significant reduction in movement rates and behaviors when *T. tridentata* were exposed to kairomones from *H. plana* even when starved for 20 days. These results have potential economic implications as there is a high economic demand in Chile for both kelp that *T. tridentata* consume and *H. plana*.

## Analysis of the n-<sup>3</sup>He Experiment

Patrick Wong, Undergraduate student, Physics and Astronomy; Robert Mahurin, Faculty, Physics and Astronomy; Robert Mahurin (Faculty sponsor) Physics and Astronomy

The n-<sup>3</sup>He experiment is a measurement of the parity violating correlation between the transverse polarization of incoming neutrons and the outgoing momentum of protons after nuclear breakup in the reaction



The asymmetry in this reaction (whether the proton is more likely to travel parallel or antiparallel to the neutron spin) is proportional to the strength of the weak nuclear interaction. This particular asymmetry turns out to be sensitive to the quark-quark weak neutral current, which can only be measured in strongly-interacting systems and for which the experimental situation is somewhat unclear.

The experiment collected data during calendar year 2015 at the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL). The SNS produces pulses of neutrons sixty times per second, which travel to the experiment in a supermirror neutron beam guide. A polarizing section of mirror aligns all the neutron spins, and alternate pulses have their polarization reversed by a radio-frequency spin flipper. The neutrons are absorbed in helium-3 position-sensitive ionization chamber. The predicted asymmetry is of order  $10^{-8}$ . To achieve our goal of a measurement to precision  $10^{-9}$  required accumulation of roughly  $10^{18}$  neutron capture events, corresponding to a year of beam time and approximately 50 TB data on disk.

In this poster I describe my search for correlations between the experiment's neutron spin flipper and the SNS accelerator time structure, which could have mimicked the parity-violating asymmetry.

## Determining the Presence of Traditional and Alternative Fecal Indicators in Murfreesboro, TN Storm Drain Biofilms

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

*Escherichia coli* (*E.coli*) is a traditional fecal indicator bacteria (FIB) used by regulators to assign impairment to recreational waters. One drawback to use of *E. coli* as an FIB is its ability to multiply in the environment outside of the host gut. Because of this, the USEPA has developed methods for detection of alternative indicators of fecal pathogen impairment with minimal replication outside of the gut, such as bacteria in the order *Bacteroidales* and viruses known as coliphages. Evidence exists for FIB proliferation in matrices outside of the gut, such as biofilms within stormwater infrastructure. Dislodged fecal bacteria from biofilms transported to a waterway could prompt or maintain federal impairment status (303d-listing) even without recent fecal inputs. Further investigation of these alternative indicators can provide supporting data to be used by regulators and agencies to create new methodology for detecting water impairment. In the present study, biofilm samples were collected from outfalls emptying into three non-impaired and three impaired Murfreesboro, TN streams at 48 and 96 hours after three different rain events (>0.15"). We investigated the presence of *E. coli* in storm drain biofilms using membrane filtration with mTEC agar. *Bacteroidales* were also assessed using quantitative polymerase chain reaction (qPCR), and coliphages were measured using a single agar layer (SAL) procedure (EPA Method 1602). The 48-hour *E. coli* concentrations (10,065 colony forming units/gram (CFU/g; n=6)) were not found to be different than the 96-hour concentrations (6,662 CFU/g; n=6). Impaired outfalls had higher *Bacteroidales* concentrations (copies/gram) at 48 hours, but not 96 hours. These results imply that secondary habitats can serve as reservoirs of fecal pathogens. Coliphage data is currently being analyzed.

### School Nutrition Recipe Development and Evaluation

Vida Harp, Undergraduate student, Human Sciences; Grace Farone, Undergraduate student, Human Sciences; Lisa Sheehan-Smith (Faculty sponsor) Human Sciences

Nutrition professionals are using new means to prepare meals for schools that are in accordance with the School Nutrition Nutrient Guidelines. The purpose of the study was to develop a new recipe that could be a meal used on a Murfreesboro City School menu. The recipe was put through FoodWorks, a nutrient analysis software, to prove compliance with School Nutrition guidelines. Eighteen kindergartener's aged five to six and two adults were selected to sample the Zucchini pizza recipe. They rated it on taste, smell, and appearance and if they would eat this item if served in the school cafeteria. A facial hedonic scale was used to cater to the age of the participants. The results varied depending on which question was answered on the evaluation sheet. For future trial, an older age sample size would provide better results for this recipe. Also, more consideration for younger age groups to disguise fresh vegetables in meals.

## You Can Take It with You: How Travel to Israel Constructs Jewish Identity for both Jewish and Non-Jewish Americans

Jeffrey LaPorte, Undergraduate student, Religious Studies; Rebekka King (Faculty sponsor)  
Philosophy

This poster explores the different types of pilgrims to Israel and the way these pilgrimages impact those who partake in them. It draws from contemporary studies of Jewish pilgrimage and on-site observations made during my own study abroad experience in Israel-Palestine. While on the trip I noted how every facet of Israel, especially in the places heavily visited by tourists and pilgrims, promote a very specific idea of what it means to be Jewish in both a religious and a political sense. The trip I took was very similar in duration and itinerary to the tours taken by many young American Jews as part of “birthright programs” and that made me curious how these trips shaped their views of Jewish identity in both the short and long term. I have constructed a poster to visually display the sights and sites experienced in Israel as well as the results of several surveys conducted on Jewish youth who participated in this style of tour (Kelner 2010; Lugo et al. 2013). My analysis synthesizes these results to outline the different ways that visiting Israel affects both Jewish and Non-Jewish American conceptions of Jewish identity.

What does BCAT do in *Cryptococcus neoformans*?

Kathryn Brittain, Undergraduate student, Biology; Erin McClelland, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

Background: *Cryptococcus neoformans* (*Cn*) is a pathogenic yeast with a polysaccharide capsule and causes fungal meningitis in immunocompromised people. A comparison of microarray data from high- and low-virulent strains of *Cn* identified a branched chain amino transferase (BCAT) gene, suggesting BCAT may be involved in pathogenesis. The BCAT gene is involved in the catabolism of branched chain amino acids. Thus, we hypothesize that BCAT is involved in the virulence of *Cn* because of its ability to affect energy production in this pathogenic yeast.

Methods: To test this hypothesis, we constructed a strain of *Cn* lacking the BCAT gene. A DNA construct was created using overlap PCR, where the noursesthericin antibiotic marker was used to replace the BCAT gene. Using biolistic transformation, the DNA construct was transformed into the wild type strain of *Cn*. The resulting transformants were tested and found to have successfully deleted the BCAT gene from the genome. We are working to insert the gene back into the knock out strain to create the reconstituted strain, using similar techniques. Results: Two strains of *Cn* lacking the BCAT gene were verified for correctness using Southern Blot Analysis. Preliminary phenotypic analysis of these strains showed a significantly smaller capsule than H99S, the wild-type strain. We will repeat this test when the reconstituted strain has been created. Conclusions: Currently we are comparing the virulence phenotypes of the knockout and wildtype strains, but the difference in capsule size suggests that BCAT is involved in capsule production and potentially virulence. Once the BCAT reconstituted strain has been created we will repeat the phenotypic analysis comparing all three strains. If the knockout strain shows a slower growth rate due to a possible defect in energy production, we will infect waxworms with each strain to determine if BCAT plays a role in virulence of *Cn*.

### Transcriptome Analysis of Clinical *C. neoformans* Strains

Kathryn Brittain, Undergraduate student, Biology; Erin McClelland, Faculty, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

*Cryptococcus neoformans* (*Cn*) is a fungal pathogen and leading cause of cryptococcal meningitis worldwide. It is fatal to immunocompromised patients and is a major cause of death for those patients. The aim of this project was to identify differences in gene expression among seven clinical strains of *Cn* isolated from patients in Botswana, Africa. Clinical strain gene expression was compared to that of a wildtype strain using RNA sequencing technologies. From strains grown under conditions mimicking that of the central nervous system, RNA was extracted and used to create cDNA libraries, which were sequenced. The results were quality checked and analyzed using bioinformatics tools. As expected, many gene expression differences (>2 fold) were observed. Over 1700 upregulation gene expression differences and more than 2300 downregulation gene expression differences were found among any of the clinical strains compared with the wildtype. Additionally, more than 6200 upregulation gene expression differences and more than 7500 downregulation gene expression differences were detected among the clinical strains alone. Currently, the study is focused on finding patterns of differential gene expression that correlate with the patient clinical data, as well as determining which biological processes and molecular functions are represented in up and down regulated genes.



*Lemonade*: Beyoncé's Recipe for Empowerment

Caleb Morton, Undergraduate student, English; Ariel Thompson, Undergraduate student, English; Alan Dempsey, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

Beyoncé has dominated the music industry with a record six consecutive number one albums in two decades. Her most recent album, *Lemonade*, was nominated for eleven categories at the 2016 MTV Video Music Awards, nine Grammys, and two Emmys. *Lemonade* excited everyone, but empowered the African-American community with its distinct references to modern and social dilemmas, including racial inequality and feminism. Beyoncé's immense presence in the arts influenced the University of Texas at San Antonio to create a course entitled "Black Women, Beyoncé, and Popular Culture." Our project takes a scholarly approach to *Lemonade*, exploring the politics of race and sex within *Lemonade* by analyzing the lyrics and choreography of the visual and aural parts of the album. In addition to primary sources (music and video), we will consult biographical and autobiographical materials as well as reviews and cultural criticism. Our purpose is to widen the critical lens through which Beyoncé is currently viewed, putting her in a black female literary tradition that celebrates black womanhood while critiquing American society. Our audience includes fans of Beyoncé's music, readers of African-American literature, and pop culture critics.

Assessment of Grazing Snail (*Tegula tridentata*) Behavior on Different Qualities of Kelp (*Lessonia trabeculata*)

Gabrielle Armour, Undergraduate student, Biology; Dennis Mullen (Faculty sponsor) Biology

The purpose of this experiment was to determine if *Tegula tridentata* exhibit awareness of the quality of kelp (*Lessonia trabeculata*) they choose to consume, and, if so, what quality of kelp is preferred. The intended audience is people who are interested in herbivory or grazing. The problem being addressed is the overgrazing of kelp. A two-and-a-half-month study that consisted of three separate trials took place over Chile's winter (June- August 2016). Arenas were set up to introduce individuals of *T. tridentata* that have previously been starved to different qualities of kelp fronds from the species *L. trabeculata* (damage types: artificially damaged, naturally damaged, and undamaged). Behavior was monitored over a 24- hour period; however, the first 4 hours were analyzed because that was when the activity was the highest. In all trials, snails showed a preference for substrates other than fronds. This indicates that *T. tridentata* may not exhibit choice in the quality of food that they consume.

Preliminary Investigation of Joints along the South-Southeast Projection of the Harpeth River Fault Zone, Central Tennessee

Brielle Paladino, Undergraduate student, Geosciences; Mark Abolins (Faculty sponsor)  
Geosciences

One of the investigators (Paladino) measured the orientation of 25 joints at three outcrops within an outcrop-poor area approx. 3.2 km to the south-southeast (SSE) of the Harpeth River fault zone (HRFZ), a largely aseismic cratonic fault and fold zone within the Nashville dome, central Tennessee. At the surface, the HRFZ consists of macroscale and mesoscale folds and minor faults and joints, and these structures define four normal fault zones: Peytonsville (on the west), Arno, McClory Creek, and McDaniel (on the east). Minor faults within the HRFZ are mostly east-side-down normal faults and strike SSE. Published aeromagnetic and subsurface data suggests that the HRFZ coincides with a basement structure that continues to the SSE beneath the Chapel Hill quadrangle. However, most joints measured by Paladino in the Chapel Hill quadrangle do not share the strike of HRFZ fractures. Specifically, most (52%) Chapel Hill joints strike  $260^{\circ}$ - $295^{\circ}$ . In contrast, only 1 minor fault out of 45 fractures (0.05%) in the Arno fault zone falls within this range, only 2 joints out of 11 fractures (18%) in the McClory Creek fault zone fall into this range, and no fractures in the Peytonsville and McDaniel fault zones fall into this range. Also, only 2 Chapel Hill joints (8%) share the published  $331^{\circ}$ - $358^{\circ}$  strike of macroscale HRFZ fault zones. In contrast, 11 Chapel Hill joints (44%) strike  $260^{\circ}$ - $290^{\circ}$ , 7 (28%) strike  $290^{\circ}$ - $315^{\circ}$ , 3 (12%) strike  $010^{\circ}$ - $050^{\circ}$ , and 2 (8%) strike  $050^{\circ}$ - $060^{\circ}$ . These findings are consistent with the interpretation that, at least at the surface, the HRFZ terminates to the north of these Chapel Hill quadrangle outcrops.

## The Growth of the U.S. Federal Government: 1915-2015

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

Over the past decade, U.S. citizens have been bombarded with the fear of the increase in government spending. The numbers are touted by policy-makers and conspiracy theorists alike, both calling for a retrenchment of government spending. However, without context, the dollar amount alone of government spending and its impact on our lives as taxpaying citizens lacks actionable meaning. In this presentation, I seek to further clarify what government authority is by looking at the contextual change in government spending and regulation. For measurement, I used the ratchet effect laid out in Robert Higg's book *The Crisis and the Leviathan*, which supposes that government spending increases during times of crisis, such as depression and war, and never retrenches back to a pre-crisis spending point. Not surprisingly, the two World Wars and the Great Depression were connected with the greatest spending increases. Along with these increases, the government also passed the most regulatory legislation during that time. Since the 1950s, regulatory executive actions have greatly decreased, but Congressional regulatory action has remained constant. Though recessions have been frequent over the past 100 years, years of war have shown the most evidence of the ratchet effect and overall increases in government spending.

A firm conclusion as to the extent of the expansion of government authority is difficult to draw, due to the change in the way the federal government operates. During the first half of the century, the president and Congress ruled with executive orders and regulation. However, since the 1950s, the direct approach has declined. Less of the actions the government takes are as direct as an executive order or Congressional act, leading to a less accurate measure of the public's perception of government authority.

## The Fischer Indole Synthesis

Alex Knight, Undergraduate student, Chemistry; Scott Handy (Faculty sponsor) Chemistry

Indoles are valuable compounds with a variety of applications from fragrance to medication. At the same time, the indole system is usually synthesized in harsh conditions. The purpose of this study is to use glycerol to create a milder set of conditions under which indole can be more effectively and efficiently synthesized. In this study, during the Fischer indole synthesis, various ketones were reacted with phenylhydrazine hydrochloride using glycerol as solvent in a microwave at 90 °C for 30 minutes. Products were then purified using water and analyzed using nuclear magnetic resonance (NMR). Some products required extra purification, such as those that were liquid products as opposed to solid at room temperature. Out of a total of eight reactions that were completed, six of the ketones were successfully converted into the desired indole products. Through the research, it was concluded that glycerol is a much more effective method of converting ketones into indole than previous methods. Further research will be continued in testing more specific groups of ketones, to narrow the scope of the best ketones for Fischer indole synthesis.

### The Skin I'm In: Who Says Black Isn't Beautiful?

Christina Hankins, Undergraduate student, English; Desiraye Williams, Undergraduate student, English; Brianna Hall, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

What is it like to grow up black and female in a country with a history of racism and sexism? Our project explores the hardships of growing up as a black girl through literary analysis and social science research. We will examine the novels of two highly acclaimed black women writers: Zora Neale Hurston's *Their Eyes Were Watching God* (1937) and Toni Morrison's *The Bluest Eye* (1970). These fictional works illustrate the harmful effects of white standards of beauty on black girls. These harmful effects were demonstrated in the famous "Doll Test" in the 1940s. The investigators, which were psychologists Kenneth and Mamie Clark, presented their findings in court during the Brown vs. Board of Education case, arguing that "prejudice, discrimination, and segregation created a feeling of inferiority among African-American children and damaged their self-esteem." To bridge the gap between the Doll Test and our own time, we will do literary analysis and also field research, such as going to toy stores and Walmart to see how dolls are portrayed based on Eurocentric beauty standards. Our purpose is twofold: to pinpoint the determiners that instill prejudice and to identify the negative effects this prejudice has on actual black girls. From oral history research, direct observation, and personal testimonies, we will also consider whether these determiners still exist: Is the price of growing up black and female the same now as it was in the 1940s? The audience for our work includes black women, people who want to know what it is like to grow up a black female, and people who want to think critically about beauty standards and what effect they have on black women.

A New Potential Treatment for Infection Due to *Cryptococcus neoformans*

Trisha Clark, Undergraduate student, Biology; Erin McClelland (Faculty sponsor) Biology

Cryptococcosis is one of the most common fatal fungal infections in immunocompromised patients and is caused by the encapsulated fungal pathogen *Cryptococcus neoformans* (*Cn*). An individual becomes infected by *Cn* when the spores of the fungus are inhaled into the lungs. According to the CDC, 1 million new cases are reported every year with approximately 625,000 deaths. Most of these cases and deaths are seen in developing countries with limited access to adequate healthcare. Cryptococcosis is typically treated with Amphotericin B (Amp B) and Fluconazole. However, these drugs cannot be used long-term because they have been shown to cause toxicity. These drugs are used for 6 months or less and will not always successfully remove the infection in that amount of time. Aurones are flavonoids that gives flowers their yellow pigment. Aurone 1009 will be studied for the inhibition of serotype A (H99S strain) of *Cn*. It will be determined if aurone 1009 inhibits growth in different medias and at high concentrations of cells. The purpose of this project is to determine the effectiveness of aurone 1009 as an antifungal treatment against *C. neoformans* to potentially replace or augment the current treatments that cause toxicity. The minimal inhibitory concentration (MIC) of serotype A strain H99S in RPMI+ MOPS, minimal media, and YPD has recently been completed and showed inhibition at 25 $\mu$ m, 100 $\mu$ m, and 900 $\mu$ m, respectively. The MIC at various cell concentrations is currently being tested. Preliminary data suggests the MIC doubles when the cell concentration is increased by a log. Future experiments plan to test the mechanism of action of this aurone, if it is static or cidal and if it is synergistic with existing antifungals.

## Enhancing Concrete Properties Through the Use of Micro-fibrillated Polyethylene Fibers

Paul Stringer, Undergraduate student, Concrete Industry Management; Jonathan Huddleston (Faculty sponsor) Concrete Industry Management

Fibers have been used in concrete for thousands of years. The Romans used straw to add tensile strength to the mortar that still supports the aqueducts to this day. Since this early introduction of fibers, a number of advancements and new applications have been identified, but each has rendered both positive and negative impacts.

Concrete producers, technicians, and finishers have found less than ideal impacts on proportioning, a prohibitive cost, increased water demand, and poor finishing applications and results. Through research at Middle Tennessee State University's Concrete Industry Management Materials Lab, micro-fibrillated polyethylene fibers have shown promising results that could be used across multiple sectors of the concrete industry.

Micro-fibrillated polyethylene fibers have been used for decades in air filters, specialty papers, textiles, rubber, composite components, and latex paints, but until this point they have yet to penetrate the concrete fiber market. It is believed their potential has yet to be explored due their size at less than five percent of the length of fibers currently found in use in today's concrete. Micro-fibrillated fibers have been found through this research to reduce shrinkage, improve impact resistance, increase freeze/thaw durability, improve compressive strength, and increase workability and ease of finishing of concrete mixtures, all for a minimum expense or a cost savings to the end user.



### Don't Say a Word: Black Women Writers & Rape

Ameera Noaman, Undergraduate student, English; Mary Claire Bennett, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

Rape is a unifying concern in black women's writing. Ntozake Shange's *for colored girls who considered suicide when the rainbow is enuf* (1975), Alice Walker's *The Color Purple* (1982), and Edwidge Danticat's *Breath, Eyes, Memory* (1994) all feature characters that fall victim to rape, their experiences with sexual violence shaping them and their relationships with others. My project will historicize black women's experiences with sexual violence, beginning with slavery, and highlight the ways black women artists have explored and expressed the trauma that results from rape. My purpose is to initiate a meaningful dialogue about how real-life cases of rape so stigmatize women that the violation can steal their own voices. One source, Jennifer L. Griffith's book *Traumatic Possessions*, discusses how black women come to terms with memories they have post trauma and how their healing process begins with them telling their stories to people in order to affirm their experiences. Although my primary method is literary analysis, and thus my sources are novels and performance pieces, I will also research rape prevention and education strategies and modern day art as well as scholarly articles on rape in the black female literary tradition. The audience for this project includes anyone interested in black female writers, rape culture/prevention, women studies, and performance art.

### Expanding Your Horizons for MTSU Students

Temiloluwa Thomas, Undergraduate student, Chemistry; Rachel Marlin, Undergraduate student, Chemistry; Abigail Williams, Undergraduate student, English; Judith Iriarte-Gross (Faculty sponsor) Chemistry

MTSU through its Women In STEM (WISTEM) Center strives to introduce science, technology, engineering, and mathematic (STEM) disciplines to young girls during their middle and high school years. MTSU has been the host of an annual Expanding Your Horizons (EYH) conference for over 20 years, bringing STEM opportunities to the girls in a day full of interactive workshops. Each workshop is led by role models and mentors who recognize the need to build the future STEM workforce. We will share what we have learned from the perceptions of over 1000 girls from past EYH conferences about STEM education and careers.

### Treat or Trick: Detection of Bacteria Associated with Foodborne Illness on Pumpkin Surfaces

Grace Farone, Undergraduate student, Nutrition and Food Science; Jorge Hurtado, Undergraduate student, Nursing; Lindsey Rose, Undergraduate student, Biology; Anthony Farone (Faculty sponsor) Biology

Fruits and vegetables that grow on the ground, such as melons, cucumbers, and squash, can come into contact with pathogenic microbes in fertilizer, soil, or irrigation water. Outbreaks of foodborne illnesses have been linked to melons and cucumbers contaminated with the bacteria *Salmonella*, *Escherichia coli*, and *Listeria*. Melons and cucumbers are typically eaten uncooked which poses a greater risk for consumption of the bacteria. Pumpkin as a food source is typically cooked, however, each year, many pumpkins are used for decorative purposes and are often handled unwashed, especially by children, also serving as a potential source of bacteria associated with foodborne illnesses. The purpose of this study is to determine the presence of fecal coliform bacteria on pumpkin surfaces marketed for decorative use during the fall season. Fecal coliforms are indicators of potential contamination with pathogenic bacteria, including *E. coli* and *Salmonella*, which can be shed from the gastrointestinal tracts of animals and humans. For this study, pumpkins from different retail locations were sampled using RODAC press plates of eosin methylene blue (EMB) agar for 3 pumpkins at each site. Following incubation at 44.5°C, plates were assessed for the presence of fecal coliforms. In October 2015, 100% of 8 retail locations had pumpkins contaminated with fecal coliforms with 92% of pumpkins sampled having fecal coliforms. In October 2016, 100% of 10 retail locations had contaminated pumpkins with 75% of total pumpkins positive for fecal coliforms. Confirmation of the bacteria as species considered fecal coliforms is ongoing using both identification by biochemical testing and genetic analyses by polymerase chain reaction. This study will raise awareness for consumers of potential risks associated with handling of root and ground-grown produce not intended for consumption.

## Uric Acid Sensing with Multi-Walled Carbon Nanotubes Modified with Zinc Oxide Nanoparticles and Cytochrome C

Robert Baltz, Undergraduate student, Chemistry; Charles Chusuei (Faculty sponsor) Chemistry

Uric acid (UA) is a chemical produced in the body following the breakdown of purines found in mammalian diets. This byproduct poses unique problems due to its limited solubility in acidic environments. A method determining concentrations of UA in the blood would help quickly and efficiently diagnose patients with increased UA concentrations. Carbon nanotubes were applied to glassy carbon electrodes (GCE) to detect UA. Carboxylic acid-functionalized multi-walled nanotubes (COOH-MWNTs) will allow metal oxides and enzymes to bind with them onto the GCE surface. ZnO was used to bind to the surface using varied sonication times. The composites were used to detect UA, and the optimal sonication time, Nafion concentration, and loading was found. We hypothesize that the incorporation of enzyme would further enhance electrochemical sensing performance. The optimal composite was bound with cytochrome C using Coulombic attraction. The effect of the enzyme to increase in sensitivity and selectivity for UA detection will be presented.

## Terrorism in Western Europe

Kerry Keitzman, Undergraduate student, Political Science; David Carleton (Faculty sponsor)  
Political Science

In the past several years, some Western European countries have been targeted by terrorists more than others. How come? This project's main purpose is to look at just that: why some Western European countries are attacked by more terrorists and others are not. Even though terrorism in Western Europe has significantly decreased since 1970, it is still a relevant and important issue in today's world. The research will be based on three independent variables: religious freedom, political participation, and unemployment. Hopefully, this can give us some more insight on the issue.

## The Trouble with Friendship: An Examination of Queer Portrayal in Children's Media

Alexander Lempin, Undergraduate student, Communication Studies and Organizational Communication; Patrick Richey (Faculty sponsor) Communication Studies and Organizational Communication

In his book *No Future* (2004), social scientist Lee Edelman writes about the power of children as vehicles for change in American culture. He argues that children are both the medium and the message for change, citing examples of adults using children in stories and speeches as a persuasive tactic. He also argues that children themselves are the foundation for lasting change, saying that “the way we groom our children will shape the future of our society” (pp. 131).

Understanding this, we can examine one of the most impactful forces on our youth: media focused on children. By utilizing several approaches within Queer Theory to examine the messages children are exposed to via children's cartoons, we can analyze representations of queer\* characters, and discuss the problems they create and perpetuate. By portraying queer characters through veiled representations like “friendship,” children's media distorts the image of the queer person. This problem with the message creates a subsequent problem in the medium.

For the purpose of this paper, we will examine three specific artifacts: *Adventure Time*, *Steven Universe*, and *My Little Pony*. These are three cartoons that receive widespread attention from adult and teenage fans for their portrayal of queer characters. We will examine these portrayals using Queer Theory to discuss how their portrayals have an effect on our culture, and whether that effect is as positive as initially perceived, allowing for academic discourse of the appropriate relationship between children and the queer image.

\*The term “queer” is used objectively to identify members of the LGBT+ community. This terminology is derived from its use in academia (i.e. Queer Theory).

### The Double-Edged Sword: A Critical Analysis of Feminist Power Figures

Alexander Lempin, Undergraduate student, Women's and Gender Studies; Bethany Hoppe (Faculty sponsor) Communication Studies and Organizational Communication

When American media covers women, it typically focuses on a select few women who have had great success. These women are referred to as “power figures” because they are iconic representations of powerful women, such as celebrities or fictional icons like Wonder Woman.

While these women are exceptional, the media makes them seem more like the norm by overemphasizing them. The media places a high emphasis on power figures, while largely ignoring issues related to gender injustice and discrimination. This leads media consumers to believe that Feminism and gender equality has progressed farther than it actually has. This problem is especially prevalent in Millennials, the highest consumers of media.

The imbalanced portrayal creates a skewed perception of progress, which ultimately makes people less likely to fight for gender equality, since they believe it has already been achieved. The media’s imbalanced portrayal and overemphasis on power figures ultimately hurts the movement by halting its progress, rather than moving it forward.

### Biolistic Transformation of *Armillaria mellea*

Rachel Gingerich, Undergraduate student, Biology; Matthew Elrod-Erickson (Faculty sponsor)  
Biology

The purpose of this project was to explore the use of a biolistic particle delivery system in the transformation of *Armillaria mellea*, a bioluminescent fungus. In order to further learn about how *Armillaria mellea* controls its bioluminescence at the molecular level, genetic tools such as transformation are needed. Transformation is a basic tool used in modern genetics to manipulate the genome of an organism. Traditional transformation methods have proven to be problematic in this species, which is why the biolistic method of transformation was investigated in this project. The biolistic particle delivery system, which is also known as a gene gun, uses subcellular sized metal particles coated in DNA to shoot cells in order to introduce the DNA into the cells. Some of the cells will then incorporate this DNA into their genome. In order to differentiate between cells that have been successfully transformed and cells that were not transformed, the DNA on the metal particles must be capable of altering the organism in a detectable manner. *Armillaria mellea* is normally susceptible to Hygromycin, an antibiotic. The piece of DNA constructed for this experiment was designed to contain a Hygromycin resistance gene so that the cells transformed with this DNA become resistant to Hygromycin. When the cells are transferred to a growth media that contains Hygromycin, the transformed cells are easily detected because they are the only cells that will grow. This poster illustrates the details of the steps involved in the construction of the DNA molecule and potentially the early results on its success in the biolistic transformation.



### Skeletal Analysis of Samburg Site (40-OB6) for Evidence of Violence and Trophy Taking

Macie Orrand, Undergraduate student, Sociology and Anthropology; Stephen Jackson, Undergraduate student, Biology; Shannon Hodge (Faculty sponsor) Sociology and Anthropology

In this poster, we will show evidence of trauma and trophy taking observed in the skeletal analysis from the Samburg Site (40-OB6) in western Tennessee, including indications of trophy taking. Skeletal remains recovered at the site show markings consistent with sharp force trauma, and evidence of cranial trauma. Analysis of the remains from this site provide a greater understanding of the health of individuals in this region, and a more complete picture of the patterns of violence from this area in West Tennessee. Archaeological evidence of violence and trophy taking in the Early Mississippian period is limited; the Samburg Site is of particular interest because there is little research in patterns of violence from the western region of Tennessee. With the skeletal analysis of the Samburg site, we hope to explain certain patterns of violence during the Late Woodland/Early Mississippian transition that might be expected with the trauma found with our analysis.

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### Examining the Validity and Utility of Pilot Selection Mechanisms at US Regional Airlines

Christopher Bearden, Undergraduate student, Psychology; Paul Craig, Faculty, Aerospace; Guy Smith, Non-MTSU university faculty collaborator, Aerospace; Elizabeth Bjerke, Non-MTSU university faculty collaborator, Aerospace; Paul Craig (Faculty sponsor) Aerospace

The aim of the present study is to inform the U.S. regional airline industry (especially smaller airlines) how effective the in-place selection mechanisms are at hiring-in pilots who will be subsequently successful in training. Generally, smaller airlines have less available resources to spend on validating their selection measures (FAA, 1997). Data were collected from 22 regional airlines during the summer of 2015. A multi-analysis approach is taken to examining the criterion validity of four regional airline pilot selection methods: unstructured interviews, simulators, technical skills assessments, and evaluations of pilot competencies. By comparing the association effect sizes or odds ratios between selection methods and training success, this study identifies the strength of the relationships different selection methods have with desired outcomes. Two criteria were established for defining airline-pilot training success: training completion and incurring no extra training. Findings suggest that simulators and technical skills assessments may not be as useful in determining whether a pilot will be successful in training, while more traditional, unstructured interviews and informal evaluations of pilot competencies may provide more useful information on whether a pilot is likely to pass training and not incur extra training.

## Gene Family Visualization Server

Ethan Willis, Undergraduate student, Computer Science; Hyrum Carroll (Faculty sponsor)  
Computer Science

The Gene Family Visualization Server aims to be available for public use by the end of the Spring 2017 Semester. It will give access to experts in Molecular Biology and Genetics to study gene-families in a way that is easily graspable, correctable, and expedient.

Gene Families are very useful but very difficult to study due to their inherently complex nature. A method developed by Dr. Seipelt-Thiemann, has been employed to visualize the relationships between genes in a gene family. This process, however, is exceptionally time-consuming and tedious. This project aims to automate that process as a means of making gene-families easier to study for experts in Molecular Biology and Genetics.

By automating this visualization technique, a user will be able to study the relationships of a gene-family in a fraction of the time previously required, which could have been in the range of +30-50 hours. This is done by providing a user-interface that allows input of raw nucleotide data and converts that information into the visualization, using specifications derived from Dr. Seipelt-Thiemann's technique.

## The Blacker the Berry: Black Women, Sex & the Media

Marteja Bailey, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

Black women are typically displayed by the media as sexual beings as if sexuality is all they have to offer. But what happens when black women have control of the camera? Is there a significant difference when black women portray themselves? Or do they cater to the stereotypes that are already inflicted on black women? Oftentimes success in a media production can stem from the perception that people already have of a race or culture rather than taking a risk to challenge it. This project shines a light on how black women are currently being portrayed in social media, music videos, TV shows and movies. I will be comparing how black women are portrayed in a variety of different productions such as *Queen Sugar* (Ava DuVernay), *Being Mary Jane* (Mara Brock Ali), *Love and Hip Hop* (Mona Scott Young) and *Lemonade* (Beyonce).] My primary research method will be to apply Adichie's theory of "the single story" to black women's portrayals in the media: are these portrayals stereotypical or liberating? In addition to close analysis of primary media sources, I will consult reviews, biographical materials, and scholarly articles on black women and the media. With these articles, I hope to raise awareness of the obvious stereotypes that are being supported by the media which makes it harder for black women to break them. The audience of my project includes all women more specifically black women in order to shine a light on the media's negative portrayal of them. Also, as a challenge for all women to help fight these stereotypes to show the world that women in general are more than just their bodies and objects for sexual pleasure.

## Droughts in a Changing Climate: A Review

Jordyn Hyden, Undergraduate student, Geosciences; Racha El Kadiri, Faculty, Geosciences;  
Racha El Kadiri (Faculty sponsor) Geosciences

Mounting evidence of rising global temperatures urge society and the scientific community with a pressing question: How is climate change affecting the intensity, duration and frequency of droughts at the local, regional and global scales? According to the Intergovernmental Panel on Climate Change, droughts have become longer and more intense, and have affected larger areas since the 1970s. This review aims to (a) estimate global drought impacts of the future by presenting a detailed global picture (*i.e.* spatial and temporal distribution) of droughts in the 21st century through a synthesis of all available past research, (b) identify the research needs and urgent gaps in the field, and (c) conduct a comparative review of the main methodologies and tools used to date to assess future droughts in a changing climate, proposing a general modeling framework for future regional studies.

### Why Do Some Western European Countries Have More Women in Government than Others?

Ashley Hobbs, Undergraduate student, Undecided; David Carleton (Faculty sponsor) Political Science

I researched why some Western European countries have more women in their government than others. I chose four cases, or countries, which were: Iceland, Ireland, Greece and Sweden. Greece and Ireland have the lowest representation of women in government in Western Europe, while Sweden and Iceland have the highest in not only Western Europe, but the whole world. Then I read many research articles that provided me with my variables and evidence. The variables I chose that were the most compelling to look at in more detail were: gender quotas, gender equality legislation, history of gender equality, and liberal governments. I used the Gender Empowerment measurement and data from the European Parliament. I found that, surprisingly, three out of the four variables had a correlation. Gender quotas, gender equality laws, and history of gender equality all had a positive correlation, while countries with more liberal governments did not have a correlation at all.

### Bioavailability of Atmospheric Mercury in Appalachian Mountain Streams

Jaylen Sims, Undergraduate student, Biology; Gale Beaubian, Graduate student, Biology; Connor Olson, Graduate student, Biology; Ryan Otter, Faculty, Biology; Ryan Otter (Faculty sponsor) Biology

Tennessee's Appalachian mountain streams are typically thought of as pristine environments, but these aquatic habitats may still be susceptible to the deposition of atmospheric mercury due to their high elevation and location. Once mercury has been deposited atmospherically, sulfate-reducing bacteria can transform mercury to its bioavailable form, methylmercury, which concentrates in primary producers (*e.g.* algae) and then biomagnifies in primary consumers (*e.g.* aquatic insects). The amount of mercury that is bioavailable has been shown to be affected by different water conditions such as temperature, sulfate, and pH. Previous studies have shown the production of methylmercury is inhibited by low temperatures and low sulfate concentrations, and is released from the sediment surface as pH decreases; however, these studies have primarily focused on lab or lake systems, and high elevation mountain streams have gone largely uninvestigated. The objective of this study was to determine the relationship between temperature, sulfate, and pH and the concentration of mercury that enters the aquatic food chain through primary consumers in four Appalachian Mountain streams. In all streams, water was analyzed seasonally for mercury, temperature, sulfate, and pH. Additionally, caddisflies (*Trichoptera*) were sampled during the summer as representative primary consumers. Results showed that the relationship between temperature, sulfate, and pH did not explain the concentration of mercury present in primary consumers. Future studies examining other water conditions affecting mercury bioavailability are needed in Appalachian mountain streams.

## A Preliminary Sensitivity Assessment Comparing Two Next Generation Sequencing Laboratory Workflows for Forensic Analysis

Adriana Swatzell, Undergraduate student, Forensic Science; Jocelyn Bush, Non-MTSU university faculty collaborator, Forensic Science; Elizabeth Montano, Non-MTSU university faculty collaborator, Biology; Hugh Berryman (Faculty sponsor) Sociology and Anthropology

Often, DNA evidence recovered from a crime scene is rarely ample in quality or quantity. Therefore, it is vital to know the limits of any assay used for forensic DNA analysis. Next Generation Sequencing (NGS) DNA sequencing technology is now being implemented and investigated in forensic laboratories. Integration of NGS into forensic DNA analysis workflows provides value by its ability to: successfully process degraded samples, reduce the cost of materials and labor time by multiplexing a large number of DNA markers into one sequencing run, and use phenotypic markers to identify persons by physical characteristics. Therefore, it is important to perform a sensitivity assessment to ultimately validate this new technology. For this experiment, the Promega PowerSeq Auto/Y System Prototype and Illumina ForenSeq DNA Signature Prep kits were evaluated on the MiSeq instrument platform. Initially, two high quality DNA samples were assessed at different titrations, ranging in amplification input from 500 pg to 15.6 pg. The same samples were processed with both laboratory workflows. Following, on separate sequencing runs, 8 mock casework samples were tested with both workflows. Data was analyzed using default analytical threshold settings using software platforms recommended in the manufacturer's instructions. Preliminary results indicated full DNA profiles were obtained for autosomal STRs at lower amplification input levels in samples processed with the PowerSeq workflow than samples processed with the ForenSeq DNA Signature Prep kit. Similar trends were observed with the mock casework samples. Genotypes for each marker were deemed concordant when the correct alleles were the most abundant one or two alleles for homo- and heterozygous loci, respectively. This assessment will be valuable for the forensic casework and academic research communities in order to demonstrate the capability of NGS to assist in their selection of an appropriate methodology.



## The Effectiveness of Chlorine Dioxide in Inactivating Influenza Virus

Mary Gormsen, Undergraduate student, Biology; Stephen Wright (Faculty sponsor) Biology

National outbreaks of avian influenza viruses have been the source of a wide range of adverse effects for the country, including the culling of thousands of birds, economic damage to commercial farms, increased product prices, and blocked international trade. Tennessee is heavily involved with the poultry industry, and an outbreak of avian influenza could have a serious economic impact. Currently, a standardized system to control and prevent the spread of the pathogenic viruses from entering chicken farms is lacking. This study evaluated the chemical compound chlorine dioxide to inactivate influenza viruses. Seven different strains of influenza were exposed to chlorine dioxide gas and tested at concentrations ranging from 50 parts per million to 500 ppm at time intervals ranging from 30 minutes to 4 hours. As the concentration of chlorine dioxide increased, the length of exposure necessary to bring the virus titer to zero decreased. At 500 ppm, virus was completely inactivated by 30 minutes. Based on our results, chlorine dioxide has the potential to be a highly effective way to inactivate influenza viruses and perhaps prevent additional outbreaks among poultry.

## Processing of Mitochondrial Stress Signals by the PINK1: Parkin Mitophagy Pathway

Wesley Riley, Undergraduate student, Biology; David Nelson (Faculty sponsor) Biology

Parkinson's Disease is a neurodegenerative disorder that effects more than 10 million people worldwide. In heritable forms of Parkinson's Disease, accounting for approximately 5-10 % of all cases, mutations can be found in the genes that code for the proteins Parkin and Pten-induced putative kinase 1 (PINK1). Both PINK1 and Parkin are components of the mitophagy pathway that identify and mark damaged mitochondria for destruction; if mitochondrial membrane potential is lost or diminished, the protein kinase PINK1 becomes concentrated on the outer surface of the mitochondria and recruits the ubiquitin ligase Parkin. The two proteins work in concert to attach phosphorylated ubiquitin (pUb) chains to the surface of the mitochondria. This constitutes a unique signature of mitochondrial damage and triggers the destruction of the pUb-labeled mitochondria by autophagy. While the behavior of this pathway has been well characterized under conditions of complete mitochondrial depolarization, how the mitophagy pathway reacts to transient or low levels of stress remains unstudied. To investigate this, we used a live cell microscopy-based approach and show that PINK1 and Parkin respond differently to transient mitochondrial depolarization. Consistent with previous studies, we found that both proteins rapidly accumulate at mitochondria after exposure to the reversible mitochondrial poison, CCCP. We now show that while PINK1 is highly sensitive to fluctuations in mitochondrial membrane potential and will dissociate if membrane polarization even partially recovers. Parkin is less sensitive and can remain associated with the mitochondria long after CCCP is washed out, possibly through association with pUb. We propose these properties of PINK1 and Parkin (i) prevent inappropriate destruction of mitochondria caused by transient fluctuations in membrane polarization, (ii) but enable the removal of damaged mitochondria that are unable to recover function. Future studies will investigate the relationship between the kinetics of mitochondrial pUb chain formation and Parkin retention.

## Investigating the Gender Bias of Cryptococcosis using Differential Gene Expression Analyses

Mahmuda Akter, Undergraduate student, Chemistry; Erin McClelland, Faculty, Biology; Rebecca Seipelt-Thiemann, Faculty, Biology; Erin McClelland (Faculty sponsor) Biology

*Cryptococcus neoformans* (*Cn*) is a facultative intracellular pathogenic yeast that is ubiquitous and commonly found in urban areas. In healthy individuals, it's usually cleared by the immune system. However, in individuals with impaired immune function, it can spread to the central nervous system, causing cryptococcosis, a life-threatening form of meningitis. People with HIV, organ transplant patients, patients going through chemotherapy are at the highest risk. Cryptococcal meningitis is fatal, killing more than 600,000 people worldwide, especially in developing countries.

Among other factors, the gender of the patient seems to play a role. About 70% of the patients with meningitis caused by *C. neoformans* are male. To investigate this link, gene expression patterns of seven strains of *Cn* isolated from HIV+ patients (3 female and 4 male) of Botswana were compared using next generation RNA sequencing. My hypothesis is that the clinical strains will have differentially expressed genes compared to the reference strain (H99S) that are common among all strains isolated from male but are different from strains isolated from females. Fifteen genes were significantly different between male and female-derived strains by 2-fold or more. Eleven known genes were upregulated by at least 2-fold and four genes were downregulated by at least 2-fold. None of the 15 genes are known virulence factors, but additional investigation into the function of each and the role they may have in pathogenesis is an important next step.

### Paleohistopathology as a Useful Tool in Osteological Remains

Regan Darnell, Undergraduate student, Sociology and Anthropology; Shannon Hodge (Faculty sponsor) Sociology and Anthropology

Paleohistopathology combines paleopathology, the study of diseases found in ancient human remains, and histology, the study of tissues microscopically. The discipline uses a microscopy process of collecting thin ground sections of a sample of human bone and looking at it under different lights (polarized or plane) or electron scanning microscopy. These investigations can be used to develop a differential diagnosis of diseases like Paget's disease, syphilis, rickets, and anemia; which can all cause morbidity or death in historic or prehistoric peoples. When looking at ancient remains, identifying possible diseases that could have caused death is important to bioarchaeologists trying to understand past cultures. Knowing how a person died allows a bioarchaeologist a glimpse into how they might have interacted with the people and environment around them. By presenting the research and examples I have observed, I intend to illustrate paleohistopathology as a useful tool for bioarchaeologists to investigate past cultures.

### Addressing Civic Issues of Unpreparedness for Natural Hazards in Tennessee

Marilyn Kelley, Undergraduate student, Chemistry; Sam Musili, Undergraduate student, Political Science; Judith Iriarte-Gross (Faculty sponsor) Chemistry

In the spring 2016 semester, the Honors Contemporary Issues in Science class, in collaboration with the National Science Foundation's Interdisciplinary Teaching about Earth for a Sustainable Future (InTeGrate) researched natural hazards in Tennessee. Using the module, Map Your Hazards, students identified natural hazards risk zones. The purpose of this research project was to equip stakeholders such as high schools, with knowledge on natural hazards and their vulnerability to these hazards. A survey was administered to locals of Murfreesboro, TN and MTSU students to obtain current statistics on public knowledge of natural hazards such as tornadoes, floods, and earthquakes. With this knowledge, the authors hypothesized methods to educate high school students, faculty and their families with useful knowledge in the event of a natural hazard occurrence. This research project concluded with recommendations for preparedness and resource allocation for a safer and more prepared community.

## Evaluating the Susceptibility of the Aromatic Amino Acids to Chlorine Dioxide Degradation

Heather Deal, Undergraduate student, Chemistry; Beng Ooi, Faculty, Chemistry; Beng Ooi (Faculty sponsor) Chemistry

Chlorine dioxide ( $\text{ClO}_2$ ) has been used for waste water treatment and as a disinfectant for sterilizing products including equipment for medical procedures and food processing.  $\text{ClO}_2$  is a highly soluble gas that has strong oxidizing capability. It can therefore be used to degrade organic and inorganic chemical pollutants in the waste water as well as reduce the levels of pathogens. It has been shown to denature and degrade proteins. The purpose of this research is to observe how quickly  $\text{ClO}_2$  reacts with aromatic amino acids including tyrosine, tryptophan, and phenylalanine as well as to identify the byproducts of these reactions. In this research, the 25 ppm aromatic amino acids solution was exposed to 5.45 mM  $\text{ClO}_2$  gas for 1 hour followed by the analysis of the amino acid byproducts using high performance liquid chromatography coupled to mass spectrometry (HPLC-MS) with electrospray ionization. After 1 hour of treatment, the levels of all three amino acids decreased. The degree of susceptibility to  $\text{ClO}_2$  from the greatest to the least susceptibility are in the order of tryptophan > phenylalanine > tyrosine. The degree of susceptibility of these aromatic amino acids to ozone treatment was also studied with the goal of devising a treatment scheme involving both chlorine dioxide and ozone for deactivating the functions of peptides or proteins.

## Alternative Splicing of flp-1 mRNA in Response to Environmental Stress in Nematodes

Jesse Noe, Undergraduate student, Chemistry; Jackson Gargaro, Undergraduate student, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

The flp-1 gene is associated with proper neurological function in the brain of *C. elegans*. The flp-1 proteins are required for various behaviors such as coordinated movement in a sinusoidal wave, and transitioning from the egg laying state to a non-egg laying state. The purpose of this project was to examine alternative splicing of the flp-1 RNA in response to environmental stress. The hypothesis was that stress would cause alternative splicing of the flp-1 RNA. To test this, nematodes were stressed with heat at 37 °C or left unstressed at room temperature. RNA was extracted and reverse transcribed. PCR was performed on the cDNA using primers designed to investigate whether exon 2 is included or skipped. Agarose gel electrophoresis was used to analyze the results. Gradient RT-PCR showed the best annealing temperature was 57.1C, and 3 specific isoforms were observed (690bp, 230bp, and 110bp). When heat shock and non-heat shock samples were compared, 110bp isoform was present in both, and 230bp isoform was present only in the control. Neither showed the 690bp isoform, surprisingly. This shows that alternative splicing is occurring in the control, and that heat shock may induce a switch to constitutive splicing. To determine if heat shock does increase the amount of alternative splicing in flp-1, quantitative RT-PCR could be used in future studies to determine the relative amounts of each isoform.

### Azaaurones: An Unexplored Scaffold for Biological Activity

Jesse Noe, Undergraduate student, Chemistry; Scott Handy (Faculty sponsor) Chemistry

Aurones are a naturally occurring compound found in yellow flower petals and fruits of some plants. These compounds give rise to its yellow color. In addition, these compounds have shown biological activity as anti-cancer, anti-fungal, and anti-trypanosomal to name a few.

Because of this, they provide a great scaffold to build upon to enhance biological activity, and it has been shown that by changing the structure of the parent aurone the biological activity can be modified as well. Azaaurones are a variation of the aurone series that displayed significant activity in the few cases that have been reported. In the parent aurone series there is an intracyclic oxygen in one of the rings, and in the aza series that is changed for a nitrogen.

These azaaurones were made by reacting an oxyindole with an aldehyde in a condensation reaction. By changing the structure of the indole and aldehyde that are reacted together to make the azaaurone, there have been changes in the biological activity.

Preliminary results here at MTSU have shown some unexpected trends when comparing the aza series to the parent aurone series. There are a few of the aza series that showed much greater inhibition, even with much less functionality. The results of these studies and a comparison of aurone and azaaurones will be presented.



Bioassay-Guided Fractionation of Antifungal Compounds from Plant Extract 23B for Inhibition of *Cryptococcus neoformans*

Kayla Conner, Undergraduate student, Biology; Erin McClelland, Faculty, Biology; Scott Handy, Faculty, Chemistry; Erin McClelland (Faculty sponsor) Biology

Background: *Cryptococcus neoformans* (*Cn*) is an opportunistic fungal pathogen that causes life-threatening cryptococcosis, often resulting in pneumonia and/or fungal meningitis, after spreading through its host. Those affected by cryptococcosis typically have weakened immune function, often resulting from HIV infection. Yearly, there are an estimated one million cases of cryptococcosis among HIV/AIDS patients, resulting in an estimated 625,000 deaths. Thus, the lack of safe, effective treatment options for cryptococcosis is a growing problem. Traditional Chinese medicine (TCM) shows promise in the treatment of cryptococcosis. Extract 23B, an extract from a plant historically used in traditional Chinese medicine, showed 92% inhibition against *Cn* in preliminary screenings. We are isolating compounds from this extract that are inhibitory against *Cn* in hopes of developing an alternative antifungal treatment. Methods: The first phase of our project consisted of alternating chromatography fractionation of extract 23B and subsequent microbiological assays to identify active fractions. Results: Current gas chromatography/mass spectrometry (GC/MS) data suggests that three compounds are spread across all active fractions. One compound has been completely isolated, and has been confirmed to inhibit *Cn* with a minimum inhibitory concentration (MIC) of 25  $\mu\text{g/mL}$ . Conclusions: We hypothesize that the remaining impure fractions contain compounds that inhibit *Cn*. We hope to structurally characterize the already pure compound, along with any other isolated compounds. We have begun a second isolation from the crude extract in order to obtain enough product for structural characterization. Once isolated, we plan to assign structures using nuclear magnetic resonance spectroscopy, GC/MS and, if solids, x-ray crystallography. We will then continue with cytotoxicity testing, and experiments to determine the active compounds' mechanism of action against *Cn* by performing MIC tests for synergy with current treatments by testing the compound(s) in combination with amphotericin B, fluconazole, or flucytosine.

## Investigation Into Anti-Herpes Simplex Virus Activity in Components of Common Chicory

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

Herpes is a common disease world-wide caused by the herpes simplex virus (HSV). The complications of the disease can be life-threatening especially in infants that become infected during pregnancy or birth and develop Neonatal Herpes. Currently there is no available vaccine or cure against HSV, making the search for a viable antiviral agent extremely important. Common Chicory (*Cichorium intybus*) is known as a coffee substitute for a long time and has been used in folk medicine as well, but there is little evidence of pharmacological mechanisms. Recent studies have shown that its components have antiviral and antibacterial properties. Given these reports, this research is evaluating different extracts of the plant to see if any of them have effective properties against HSV. Forty-four different *Cichorium intybus* extracts have been prepared by the Chemistry department of MTSU. These extracts were tested in Vero cells for cytotoxicity and anti-HSV activity. From these samples, the wild chicory #7 extract was selected as it showed an average 87.7% virus inhibition with less than 1% cytotoxicity at 50 $\mu$ g/mL concentration. Ongoing research will clarify these results as well as identify the most potent concentration. The isolation and identification of a pure compound with anti-herpes activity would enable investigation into possible mechanisms.

Petrographic and Geochemical Investigation of Magma Mixing at Olallie, Pinhead and Clear Lake Buttes, Northern Oregon Cascade Range.

Emily Cunningham, Undergraduate student, Geosciences; Tyler Smith, Graduate student, Geosciences; Amanda Corey, Undergraduate student, Geosciences; Warner Cribb, Faculty, Geosciences; Warner Cribb (Faculty sponsor) Geosciences

This research examines the petrographic, major element and trace element characteristics of three small Quaternary buttes located in the Cascade Range Volcanic Arc between Mt. Jefferson and Mt. Hood: Clear Lake Butte (CLB), Pinhead Buttes (PB), and Olallie Butte (OB). The research investigates whether CLB, PB, and OB exhibit geochemical and/or petrographic evidence of open-system magma mixing similar to that which occurs at Mt. Hood and Mt. Jefferson, or whether the smaller CLB, PB and OB magmatic systems were closed and dominated by fractional crystallization. The research has potential to illustrate similarities and differences between adjacent magmatic systems of similar age, yet different scale. Petrographic evidence for magma mixing (plagioclase and pyroxene zoning, sieving, reaction rims) is clearly exhibited by OB samples, while both CLB and PB samples lack widespread disequilibrium textures. Major element oxide trends are consistent with fractional crystallization, but show narrow ranges of concentrations and non-overlapping compositions between PB, OB and CLB. All three buttes are characterized by narrow ranges of incompatible and compatible trace element concentrations. CLB, PB and OB all exhibit LREE enrichment and lack significant HFSE depletions, with PB exhibiting greatest enrichment in REE. These results suggest that CLB, PB and OB magmas were derived from compositionally similar, but unique mantle sources, and that their magmas were not co-genetic. Geochemical data is consistent with fractionation of observed mineral phases as the dominant magmatic process at each butte, although disequilibria textures indicate a history of magma mixing at OB, and all three buttes exhibit narrow major and trace element compositional ranges such as those attributed to magma mixing at Mt. Hood.

### Hidden Dangers in Color Powders

Robinson Summer, Undergraduate student, Chemistry; Beng Ooi (Faculty sponsor) Chemistry

Many color powders have been traditionally used for thousands of years in India for ceremonies, and have recently gained popularity among the western countries as a special effect for concerts, 5k runs, and recreational nightlife. While the companies that manufacture the powders claim they only contain cornstarch and food dyes, several incidents of fire and blindness caused by the powders have initiated further testing to determine if the color powders are safe for public use. The focus of this analysis will be on the color powders used in the 5k color runs. The dyes were extracted from the color powders and analyzed by gas chromatography-mass spectrometry (GC-MS), Fourier Transform infrared spectroscopy (FTIR), and X-ray fluorescence spectrometry (XRF), and UV spectroscopy. The tentatively identified analytes will be compared with the nine FD&C approved food dyes as well as with commonly occurring dyes reported in spectral databases or published literature. The compounds found in the color run dyes will be analyzed for flammability, toxicity, and carcinogenicity as a guideline for safety.

## Role of Archibald Belcher in Establishing the Tennessee Academy of Science (1912–1924)

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

Archibald Belcher was the first professor of chemistry and physics at Middle Tennessee State Normal School (MTSNS), but his contributions to the school and especially to the Tennessee Academy of Science (TAS) have been largely overlooked. The first semester of MTSNS began in 1911, followed closely by the founding of the TAS in 1912. This project's goal is to exhaust all archival sources of this interaction in order to construct a more complete picture of the early days of both institutions. This included a review of the late Professor James Corgans' published and unpublished papers concerning the history of the Tennessee Academy of Science as well as issues of the *Transactions of the Tennessee Academy of Science* (1912–1917), and the *Journal of the Tennessee Academy of Science* (1926–present). Additional archival materials reside at the Tennessee State Archives, the Nashville Public Library, and the Albert Gore Research Center and James Walker Library at MTSU. This project confirmed the early involvement of Archibald Belcher in establishing the Tennessee Academy of Science as an executive officer who also gave presentations at TAS meetings as a member, and the current poster will document the details of his involvement. The results of this work should be useful to anyone interested in the development of science departments at MTSU or in the general history of Tennessee science.

## The Effects of Environmental Cues on Dormant Egg Production in an Exotic Zooplankton

Camille Gilley, Undergraduate student, Biology; Melissa Pompilius, Graduate student, Biology; Robert Fischer, Faculty, Biology; Robert Fischer (Faculty sponsor) Biology

*Daphnia lumholtzi* is an invasive zooplankton species that has spread rapidly throughout the United States since its accidental introduction in 1989. Because of its ability to rapidly colonize diverse habitats, *Daphnia lumholtzi* provides a unique opportunity to investigate the traits that characterize successful aquatic invaders. One trait that may support rapid range expansion is the production of dormant eggs (DE's) that can be dispersed to new environments by migratory animals and human activities. Some studies have suggested that *D. lumholtzi* produces more DE's compared to native *Daphnia*, contributing to rapid expansion in this species. DE's are typically produced when environmental cues induce a population of asexually reproducing females to generate males, which then fertilize the DE's. While it is unclear which cues induce DE production by *D. lumholtzi* in new habitats, some studies suggest that multiple cues may be required, including changes in temperature, population density, and water quality. In this study, we investigated the effects of combined environmental cues on DE production in three distinct clones of *D. lumholtzi* by varying the initial population density coupled with changes in temperature to simulate cooling seasons (from 22°C to 16°C) or warming seasons (from 23°C to 30°C). Clones were kept in one liter aquaria and monitored for production of males, population growth, and DE production. Preliminary results show that low population density (5 individuals/L) plus warming temperatures stimulated population growth (10 individuals/L/day) by asexual reproduction, while high density (10 individuals/L) populations began producing males at moderate temperatures (17-23°C) and produced DE's when temperatures were increasing (23-30°C). Experiments are underway to determine if there are differences in responses to these environmental cues among the three *D. lumholtzi* clones.

## What is the Best Fabric to Maintain Proper Odor Control for Alzheimer Patients?

Kyndal Cheatham, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor)  
Human Sciences

“Dementia is not a specific disease. It’s an overall term that describes a wide range of symptoms associated with a decline in memory or other thinking skills severe enough to reduce a person’s ability to perform everyday activities (Alzheimer’s Association).” For example, people with dementia can experience difficulties with using the bathroom. Odor control is caused because of incontinence.

A fair assumption would be that some fabrics trap more odor than others, but sweat alone does not produce a bad odor. The first question to research when this topic came to mind was, which gym gear traps the most odor? “According to new research from Callewaert and colleagues at Ghent University in Belgium, Pungent bacteria from our skin grow more readily on certain workout shirts, namely those made from synthetic textiles like polyester (Akpan).” These European scientists conducted a study on 26 healthy individuals. While participating in a spin class, the participants wore t-shirts made from polyester and cotton. After the class the t-shirts were placed in plastic bags and stored in the dark. After 28 hours, the verdict was polyester held more odor than cotton based fabric. As a result, the soiled polyester shirts wound up holding more Micrococci bacteria than cotton shirts. Natural textiles absorb the sweat, allowing synthetic fibers to flush out bacteria. Natural wool contained every germ tested by the scientist.

In conclusion, this study could help inform clothing makers on what is the best fabric to maintain proper odor control for the Alzheimer patients. “Many manufactures have started adding antimicrobials, like nanosilver, to their clothes,” says coauthor Nico Boon. My recommendation would be to create hybrid clothing. This is where the fabric that comes in contact with their private areas, would be make with cotton. This will eliminate heat and make the patients more comfortable.

## Why Did Some Countries in Arab Spring Experience a Regime Change While Others Did Not?

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

The Arab Spring uprisings gives us an opportunity to examine multiple countries that had a regime change at a rapid rate. This event was covered extensively by international media outlets, showcasing multiple protests; some peaceful and others violent. With multiple MENA countries having a regime change within a similar time period, it is important that we try to understand what conditions led to, and assisted the transition demanded by the people. This could potentially expose future indicators for political instability and forced transition. I have compared countries, utilizing the Most Different Systems Method, based on factors that were believed to be significant in determining regime stability during Arab Spring. I am hopeful that, regardless of the outcome, these results will prove useful in better understanding the Arab Spring uprisings.



## Synthesis of a Series of Highly Quadrupolar Liquid Crystals

John Lasseter, Undergraduate student, Chemistry; Beata Lukasik, Visiting scholar, Chemistry; Piotr Kaszynski, Faculty, Chemistry; Andrienne Friedli (Faculty sponsor) Chemistry

Sequential regioselective substitution of the [*closo*-B<sub>12</sub>H<sub>12</sub>]<sup>2-</sup> cluster with onium fragments yields highly quadrupolar 1,12-derivatives. This class of compounds is interesting for their photophysical (NLO) properties. Treatment of a previously reported sulfonium derivative of [*closo*-B<sub>12</sub>H<sub>12</sub>]<sup>2-</sup> with *p*-methoxyphenyliodonium diacetate led to a mixture of 1,7- and 1,12-substituted [*closo*-B<sub>12</sub>H<sub>12</sub>]<sup>2-</sup>iodonium intermediates. Reaction of this isomer mixture with *p*-methoxypyridine as a nucleophile gave the *p*-methoxypyridinium derivatives. The isomers were separated by column chromatography and both isomers exhibited MTSU blue fluorescence under 254 nm UV light. Subsequent dealkylation of the 1,12 isomer with LiCl in DMF gave the corresponding pyridone, which is then O-alkylated with several alkyl triflates, yielding quadrupolar derivatives. In this presentation, we will report further details about the synthesis and characterization of the new compounds, with particular focus upon the methoxypyridinium derivatives and their characteristics. This project is supported by NSF DMR-1611250.

## The Mode Effects in Smartphone Surveys; Analysis using the Item Response Theory (IRT)

Jeeun Yi, Undergraduate student, Psychology; Ying Jin (Faculty sponsor) Psychology

More than 90% of Americans owned smartphones these days, and surveys using smartphones have become a new trend in research fields. However, few researchers have studied the effectiveness of using smartphones as a survey method. In this study, the effects of two modes of smartphone surveys (voice vs. text) were compared, by employing the Item Response Theory (IRT) model. Non-confidential data ( $N = 648$ ) collected from 5 survey questions on attitude toward healthy food were used (Conrad & Schober, 2017). An example of the survey questions was asking participants' food preference such as "maintaining a healthy diet." Prior to the analysis of the mode effect using IRT, demographic characteristics such as age, income, gender, and race were examined to evaluate sample homogeneity. The results showed that none of these demographic characteristics had a significant effect on the responses of the two survey modes. In the IRT analysis, the item difficulty parameters ( $b$  thresholds) for the voice group were lower than those for the text groups, indicating that participants were more likely to respond positively to healthy food when using the voice surveys. In addition, the IRT calibrated attitude toward healthy food was significantly higher when using the voice surveys than when using the text surveys ( $t = 7.368, p < .001, d = .579$ ). However, the information function based on IRT analysis revealed that the text surveys provided more information than the voice surveys. Based on the results, we concluded that participants were more likely to exaggerate their attitude toward healthy food when the surveys were given in the voice messages, whereas participants taking the text surveys tended to respond more honestly. Therefore, our study suggested that the mode effects should be considered in future surveys using smartphones.

## Noise Reduction of Unmanned Aircraft Propellers by Utilizing Barn Owl Biomimicry

Braxton Harter, Undergraduate student, Aerospace; Nate Callender (Faculty sponsor) Aerospace

Recently, the unmanned aircraft systems (UAS) industry has been experiencing rapid growth in both civilian and military markets. This growth has been checked by Federal Aviation Regulation (FAR) Part 107. FAR Part 107 states that UAS must be operated below a maximum altitude of 400 feet, or within 400 feet of any structure. This law creates a high concentration of UAS near ground level, and thus the noise created by such devices could be an annoyance to the general public. The main source of noise, the aircraft propellers, can be modified to create less noise without compromising thrust to an unacceptable amount. Barn owls are noted for their exceptionally stealthy flight and achieve such stealth with several characteristics: the addition of feathers in the form of a leading-edge comb; a fringe formed by the feathers at the trailing edge; and a velvet-like covering on the wing upper surface. By utilizing biomimicry, these characteristics can be applied to UAS propellers to reduce sound pressure levels (SPL) while in operation. The aim of this study is to analyze and optimize the effects of applying a leading-edge comb to UAS propellers. The modifications applied to propellers do not add or remove mass, but are constructed by reshaping the leading edge into hub-oriented combs. Multiple comb variants are tested on their ability to reduce SPL while maintaining an acceptable amount of thrust through the operational range of the propellers. Initial leading edge studies have achieved up to a 5 dBA reduction in sound pressure levels while maintaining thrust. By optimizing these designs, more efficient propellers can be created to aid UAS pilots in achieving quieter, less disruptive flights.

## Upper Extremity Eccentric Resistance Training Postpartum and Incomplete Spinal Cord Injury

Corey Gray, Undergraduate student, Health and Human Performance; Whitley Stone, Graduate student, Health and Human Performance; Sandra Stevens (Faculty sponsor) Health and Human Performance

**Catalyst:** A 34-year-old, postpartum female with a long-standing, cervical incomplete spinal cord injury (iSCI) presented with general weakness of the upper extremity and core, likely exacerbated by the pregnancy. **Audience:** Since regular physical activity is recommended, exercise professionals working with special populations might benefit from an investigation that determines the appropriateness of resistance training in postpartum females with iSCI.

**Scholarship:** To date, there is little information available on exercise prescription in the described population. At baseline, investigators assessed isometric strength and eccentric muscular endurance to prescribe exercise and evaluate progression. Isometric strength was measured bilaterally using elbow flexion and extension, shoulder abduction, flexion, and extension. The eccentric endurance assessment (EEA) focused on major upper body muscle groups.

**Intervention:** The study was approved by MTSU's IRB and the participant supplied informed consent. An eccentrically biased upper body exercise program was implemented 2 days per week for 4 weeks. Eccentrics were implemented due to the lower metabolic cost and higher work output. The participant was given an "exercise menu" consisting of 4 to 6 dynamic eccentric exercises to choose from per session. Each session required 2-3 sets of 8-14 eccentric repetitions. Exercise choices included upper body pushing and pulling movements using resistance bands and an adapted resistance training machine. Strength reassessments followed the same protocol as the initial physical examination. Progression was based on perceived effort and total exercise volume. **Results:** The sum of isometric strength was 164.5 pounds at baseline and 142.5 pounds at post-test. Eccentrically, the participant increased at least 3 repetitions per exercise, indicating gains in strength. The variability in isometric strength was likely due to unstable baseline/post-test hypertonicity. **Progress:** Eccentrically biased strength training is effective and can be performed safely in postpartum women with iSCI. Increased strength in this population may aid in the physical demands of motherhood.

## Gerber Technology Research

Chelby Price, Undergraduate student, Human Sciences; Rick Cottle (Faculty sponsor) Human Sciences

Discovering the tools and resources used for Gerber Technology was an interesting search. This program is mainly used in apparel manufacturers as a backbone for producing items for the fashion industry or major fashion stores. Gerber Technology is basically the computer version of patternmaking. It is more technical and requires exact numbers and measurements. Gerber Tech uses a variety of machines to get the job done. It may take up to eight different machines to create one pair of pants.

I also discovered that Gerber Technology has a University people can attend and obtain the knowledge of this wonderful program. People can attend physical classes located within select colleges across the world, or people can register online and follow demos as well as receive assistants from lecturers on-line. Purchasing the Gerber Technology program at home can be very costly, but the benefit of this program goes beyond the believable. Having a career working with this program pays major bucks. For example, a Product Manager gets paid an estimated \$109,044 per year working with a primary background in Gerber Tech.

At Middle Tennessee State University, we provide Gerber Technology software within the computer lab of TXMD building. What they provide is the software for patternmaking which also has the machine to print out patterns as well. To gain the knowledge of how to use the Gerber Tech program, students will have to register for class "Patternmaking II." There is also a book located in MTSU's library that provides the knowledge of how to use The Gerber Technology software. The book is titled *The E-Myth Contractor* and is written by Michael E. Gerber.

## Effect of Overdose Drugs on the Human Postmortem Microbiome

Emily Brackett, Undergraduate student, Forensic Science; Gulnaz Javan, Non-MTSU university faculty collaborator, Forensic Science; Frank Bailey, Faculty, Biology; 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 and have decreasing accuracies as the PMI grows larger. Recent studies in forensic microbiology have been looking at the postmortem microbiome as a potential new method for PMI determination. Postmortem microbiome studies involve the investigation of organized changes in bacterial activity in the internal organs that happen after a person dies and can provide data that can be used as evidence in criminal death cases. Several aspects of the postmortem microbiome have been examined, but the effects of overdose chemicals on the postmortem microbiome is unknown. The objectives of this project are to determine the effects of illicit and abused drugs on the postmortem microbiome in 10 cases of fatal criminal drug overdose. The hypothesis being tested is that the overdose drugs will negatively impact the microbiome and will slow the movement of bacteria into the organs. Liver tissue samples from 10 different cadavers of overdose victims with varying PMIs were homogenized in water and drugs were extracted with a basic extraction and analyzed following *Tennessee Bureau of Investigation Toxicology Quality Assurance and Procedures Manual 8.5* to determine identity/concentration of the overdose chemical(s). Varying concentrations of several different drugs of abuse were detected in each of the liver samples. The most frequently detected drugs were methadone, hydrocodone and methamphetamine/amphetamine. Bacterial DNA will be extracted from the samples and the identity of the bacteria determined using next generation sequencing. These data will be compared to previous postmortem microbiome studies from non-overdose deaths.

## The Enemy of My Enemy is My Lover

John Dangerfield, Undergraduate student, English; Laura Dubek (Faculty sponsor) English

Abstract: The most disappointing aspect of Zora Neale Hurston's career is that she was not awarded the proper accreditation that she deserved, even after her death in 1960. A decade after the Harlem Renaissance Hurston delivers her Southern story in 1937, during the final years of the Great Depression, a time where making ends meet often meant an emotional divide between husband and wife. Although *Their Eyes Were Watching God* was unfairly overlooked, Hurston's work is now standard fare in either high school or college curriculums, with its focus remaining on her female protagonist, Janie Crawford. My project will put the critical spotlight on the male characters within Hurston's novel. Hurston offers a powerful message about the importance in finding love, but more specifically, finding love in one's self. My project will focus and expand on the idea introduced by Chimamanda Ngozi Adichie known as the "single story" exploring the black men within Hurston's novel. My research will show how Jody and Tea Cake complement one another in Janie's life, and how both men reinforce Hurston's caution of male reliance. My intention with this project is to offer insight into some reasoning behind the single story regarding black men. My source material for this project will include Hurston's novel itself, and my method will be literary analysis. My research will include scholarly reviews on the novel as well as contemporary statistics to illustrate my point. My goal is to show ways in which Logan, Jody, and Tea Cake all either fail to honor Janie as an independent woman or challenge her natural right to be so. This analysis will interest anyone interested in black women's history, black men's disorientation within the marriage, and men in young marriages in today's time.

### Interpreting Semantics from Natural Language via Synonymic Keywords

Sam Remedios, Undergraduate student, Computer Science; Alec Frey, Undergraduate student, Computer Science; Taylor Harvin, Graduate student, Computer Science; Ryan Florida, Undergraduate student, Computer Science; Sal Barbosa (Faculty sponsor) Computer Science

Historically, one of the most challenging tasks when processing natural language has been interpreting the semantics, or underlying meaning, of a sentence. In this research project, we present an architecture which extracts meaning by searching for keywords, words and their synonyms which exist in a programming language's syntax, and which interprets this meaning as compilable code. We developed an environment in which to test various methods of processing commands, and hope to move forward attempts at converting natural human language into a form computers can understand.



## Runtime Verification of a State Diagram For Robotics

Taylor Harvin, Graduate student, Computer Science; Zhijiang Dong (Faculty sponsor) Computer Science

Ensuring proper performance of a robotic system is critical, but including error checking and verification code directly into the system typically clutters code, leads to crosscutting issues and ultimately unnecessarily complicates development. In addition, systems typically follow a state diagram and are expected to strictly follow each transition from state to state. To help alleviate these issues, we utilized AspectJ, JavaMOP, and linear temporal logic in a unique way to separate error checking and correcting from the primary methods in a given system to ensure proper actions of a robotic system per directions in the state diagram. In our case, a Lego EV3 robot with the Java based LeJOS API was developed to play a basic game of soccer. Utilizing previously mentioned tools, all runtime verification code and logic was separated out from the base soccer code in a clean, unique, and powerful way. Including this runtime verification based code into the system ultimately introduces more work for the system, but based on results, the impact is negligible for relatively modern systems.

## Plasma and Muscle Amino Acid Concentrations in Insulin Resistant Compared to Normal Horses in the Fed and Fasted State

Erica Macon, Graduate student, Agribusiness and Agriscience; Rhonda Hoffman, Faculty, Agribusiness and Agriscience; Patty Graham-Thiers, Faculty, Agribusiness and Agriscience; Rhonda Hoffman (Faculty sponsor) Agribusiness and Agriscience

The effects of insulin resistance on protein and amino acid (AA) metabolism have not been documented in horses, despite knowledge that insulin stimulates the incorporation of AA into proteins and decreases protein degradation in skeletal muscle. The objective of this research was to investigate protein metabolism in insulin resistant (IR) compared to Normal horses. Horses initially underwent an oral sugar challenge (OST) to confirm IR vs. Normal status. Blood samples were collected before and at 60, 75, 90, 120, 180 min after administration of Karo Light Syrup (0.15 mL/kg of BW) for determination of plasma insulin and glucose. Based on the OST, eight horses (16 + 3 yrs), 4 IR and 4 Normal, were studied while consuming a balanced diet at 2% BW, which met or exceeded requirements. After a week of dietary adaption, blood samples were taken at 0, 1, 3, 4, and 6 h post-prandial for determination of plasma AA. On D8, muscle biopsies were collected. Glucose was analyzed using an enzymatic assay and insulin via radioimmunoassay. Plasma and semitendinosus free AA were determined using reverse-phase HPLC of phenylisothiocyanate derivatives. Data were analyzed using a mixed model with repeated measures (SAS), with time and group as main effects. The groups were confirmed from OST data by higher insulin ( $P = 0.020$ ) and a trend for glucose ( $P = 0.055$ ) in IR vs. Normal horses. There were no differences between IR and Normal for plasma free AA or semitendinosus muscle free AA. Contradictory to this study, hyperinsulinemic clamp procedures in healthy horses and pigs lowered plasma AA, with similar results reported in healthy and diabetic humans. Lack of variation in AA concentrations between IR and Normal horses suggests that insulin resistance does not affect AA absorption into the plasma pool or incorporation into the muscle in horses.

## A Greener Approach to One-Pot Copper-Catalyzed Azide-Alkyne Cycloaddition (CuAAC) Reaction of Aryl Bromides in a Deep Eutectic Solvent

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

Cu(I)-catalyzed azide-alkyne cycloaddition reaction (CuAAC) involves reaction between an organic azide and a terminal alkyne in the presence of Cu(I) catalyst leading to the formation of 1,4-disubstituted 1,2,3-triazole. It has been widely utilized in the field of peptide modification, synthesis of biological inhibitors of HIV-I protease, polymer functionalization, material chemistry and biorthogonal chemistry. Since organic azides are potentially explosive in nature, necessity of reaction protocols that avoid azide handling are of high importance. In an effort to avoid the hazards of isolating and handling azides, many protocols have adopted its in situ generation from halide precursors. This option is readily accomplished for alkyl azides but is more challenging for aryl halides. Since aryl iodides are highly reactive compared to aryl bromides, the use of bromides in CuAAC reaction is limited. In this research, we have developed an environmentally friendly, copper (I)-catalyzed, one-pot protocol for the synthesis of 1,4-disubstituted 1,2,3-triazole employing aryl bromides which are relatively cheap, more stable and less hazardous compared to aryl iodides. Reactions were carried out under ambient conditions using a cheap, safe and biodegradable “deep eutectic mixture” of choline chloride and glycerol in the presence of a ligand dimethylethylenediamine (DMEDA). Unlike conventional organic solvents, deep-eutectic solvent possesses low vapor pressure, non-toxic, and non-flammable properties making them a promising alternative for the traditional solvents or ionic liquids. Further, we are able to recycle the solvent, catalyst, and ligand several times, thereby increasing the attractiveness of this method.

## Music Production in the Style of Dr. Dre: A Study in Auteur Production Techniques (1998-2001)

Sam Mentzer, Graduate student, Recording Industry; Joseph Akins (Faculty sponsor) Recording Industry

This research is focused on Dr. Dre's production process, which includes the recording techniques and equipment utilized in the creation of hip-hop and R&B instrumentals from the years 1998-2001. These prolific years include his collaboration with several notable co-producers and studio musicians whom are spotlighted as well. Dr. Dre achieved some of his highest accolades during this period through an evolving approach that included a mastery of his own unique techniques and the ability to recognize and harness the talent not only in the featured artists, but in the musicians recruited for his production team as well.

In the fall of 2016, I completed three instrumental sound-alikes of Dr. Dre productions, complete with written analysis. Sound-alikes are recordings that attempt to mimic an original production as closely as possible. I also finished an in-depth research paper, which prepared me to implement Dr. Dre's production methods on my own original compositions (all taking place in MTSU's on-campus recording studios). In present time, I am in the midst of recording and mixing four original instrumentals that were informed by Dr. Dre's production process.

Dr. Dre is the most financially successful hip-hop producer of all-time and he is not limited to his vast knowledge of recording equipment and his engineering and mixing prowess. Dr. Dre is an unquestionable talent scout as well, having launched the careers of the likes of Snoop Dogg and Eminem. He is the quintessential auteur music producer: one who puts a personal stamp on the music of others. Surprisingly, there is a lack of information on this topic; especially considering the profound impact Dr. Dre has had on the genre. By studying successful music producers, aspiring producers and songwriters of all genres can absorb the information and use it to formulate their own creative sound.

## The Security and Effectiveness of Mobile Payment Applications

Dee Xiong, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)  
Engineering Technology

Mobile payment applications have become more popular over recent years. Many mobile payment applications claim to be secure, easy to use, and convenient when making transactions during shopping. The applications are mostly available for some of the latest smartphone models since most are equipped with and use Near Field Communication (NFC) wireless technology. Despite the claims of security, ease, and convenience they are still the main concerns for users since mobile payment applications require the input and storage of sensitive information such as credit card accounts and pin numbers. This analysis will examine the research on the security and effectiveness of mobile payment applications. It will also discuss the social impact and influence of using the applications based on the convenience for its intended users.

### The Forcing Resonant Polynomials of Cata-condensed Benzenoid Systems

Xi Chen, Graduate student, Mathematical Sciences; Dong Ye, Faculty, Mathematical Sciences; Xiaoya Zha (Faculty sponsor) Mathematical Sciences

A benzenoid system can be used to model the skeleton graph of a benzenoid hydrocarbon or graphite molecules. Our project is to establish relationships between chemical properties and molecular structures. Furthermore, our methods and results can be used to guide experimental systemizations of new nanostructures in material sciences.

Mathematically, a benzenoid system is a finite 2-connected plane bipartite graph in which each interior face is bounded by a regular hexagon of side length one. A benzenoid system is cata-condensed if all vertices appear on its boundary. A set of disjoint hexagons  $H$  of a benzenoid system  $G$  is a forcing resonant set if a subgraph consisting of deleting all vertices covered by  $H$  from  $G$  has a unique perfect matching. In this paper, we propose an algorithm to calculate the polynomial of forcing resonant set of a cata-condensed benzenoid system  $G$ . Further, we define a new indicator, the coefficient vector, which can be used to better predict the stability of  $G$  than other indexes such as Clar number and Fries number. According to our results, an isomer with larger the coefficient vector is more stable.

Using an Explicit-Reflective Exemplar Strategy in a Biology Course to Develop Pre-service Elementary Teachers' Understandings of Nature of Science and Scientific Inquiry

Jennifer Parrish, Graduate student, Mathematics and Science Education; Grant Gardner (Faculty sponsor) Biology

Developing K-12 science teachers' epistemological understandings of nature of science (NOS) and scientific inquiry (SI) has been and continues to be a major goal of science education and there is consensus that NOS and SI are vital to the development of a scientifically literate citizenry (Driver, *et al.*, 1996). Unfortunately, most prospective elementary teachers hold views of NOS and SI which are incongruent with science reform recommendations and are therefore unable to effectively implement science instruction to help their students develop adequate understandings. The purpose of this study was to compare the effectiveness of a researcher-created exemplar strategy to a traditional NOS instructional approach in the context of a science course for prospective elementary teachers. A quasi-experimental, mixed-methods design was used to compare the treatment strategy ( $n = 22$ ) to traditional NOS instruction ( $n = 13$ ). Participants in both conditions showed gains in their views of NOS and SI, but participants in the exemplar condition reflected on NOS and SI more often than participants who received traditional instruction.

## Adoption and Implementation of Water, Hygiene, and Sanitation Policy Guidelines Among Primary and Secondary Schools in Ghana

Angela Bowman, Graduate student, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Introduction:** The World Health Organization (WHO) lists water, sanitation and hygiene (WASH) as key to the prevention and management of several communicable diseases (Boisson *et al.*, 2016). In Ghana, national level policies and guidelines seek to address WASH related problems through schools. School health policies provide guidelines on several priority areas relating to WASH. This study examines WASH practices and predictors of WASH related policy implementation.

**Methods:** Using data from the first-ever Ghana Global School Health Policies and Practices Survey (Ghana-GSHPPS), we identified questions assessing WASH items as outlined in the current School Health Education Program Policy Guidelines. Complex sample tables and logistic regression were utilized to calculate prevalence estimates and to examine the relationship between WASH variables and school characteristics.

**Results:** Nationally, 78.9% of schools indicated having toilets/latrines, 44.3% had hand-washing facilities, and 81.8% provided soap for hand-washing. Additionally, 67.6% reported having a clean source of drinking water, 30.4% reported testing water for safety in the past 12 months. Schools who had a group or committee to guide health policy implementation were 2.25 (95% CI: 1.83 – 2.76) times as likely to have hand-washing facilities, 1.42 (95% CI: 1.13 – 1.78) times as likely to have clean drinking water, and 1.70 (95% CI: 1.34 – 2.17) times as likely to test water for safety.

**Conclusion:** This study demonstrates the extent of deficit present among Ghanaian basic and high schools concerning implementation of WASH related policies. Schools without a group or committee to inform health policy are at risk for lacking access to clean drinking water or hand washing facilities.



## Exploring Horse Reactivity and Habituation Across Work Types

Chloe Wires, Graduate student, Agribusiness and Agriscience; Rhonda Hoffman, Faculty, Agribusiness and Agriscience; Anne Brzezicki, Faculty, Agribusiness and Agriscience; Rhonda Hoffman (Faculty sponsor) Agribusiness and Agriscience

Horse behavior is affected by level of training, within the same type of work. The purpose of this research was to identify patterns of behavior in horses trained for different types of work. Eighteen adult horses, six each trained for mounted patrol, equine-assisted activities and therapies (EAAT), or show, were individually turned loose in an 18 m diameter round pen and exposed to three novel stimuli: fog machine, 5.2 m tall air dancer, and the noise of a paintball gun. Each horse wore a heart rate (HR) monitor and Fitbit. Following a 30 s adjustment period to the pen, reactivity to each stimulus was measured over an additional 30 s. Each stimulus was ceased for a 60 s break, then resumed and habituation time was determined after a drop in HR. A mixed model with repeated measures (SAS) was used to analyze effects of work type on HR, habituation, and steps. The air dancer caused no difference in HR between groups. The fog machine raised Patrol HR greater than EAAT ( $P = 0.023$ ) and Show ( $P = 0.012$ ) with no difference between EAAT and Show. The gun raised Patrol HR greater than EAAT ( $P = 0.046$ ) and Show ( $P = 0.027$ ) with no difference between EAAT and Show. The fog or gun elicited no difference in habituation between work types. EAAT habituation to the air dancer tended to be greater than Show ( $P = 0.073$ ). The air dancer and gun caused no difference in steps between groups. The fog raised Patrol steps greater than EAAT ( $P = 0.017$ ) and Show ( $P = 0.014$ ) with no difference between EAAT and Show. These results agree with previous studies while also showing that type of work affects reactivity when exposed to novel stimuli.

## Computational Advances in High-Throughput Modeling of pH-Sensitive HIV Envelopes

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

After three decades of research on human immunodeficiency virus (HIV), the causative agent of acquired immunodeficiency syndrome (AIDS), a vaccine has yet to be discovered. Most theoretical and experimental work on HIV vaccines has focused on the relevant molecular interactions at systemic pH levels, but HIV is typically transmitted sexually at mucosal pH levels. We previously developed a computational approach for calculating pH-sensitivity which predicted optimal transmission at mucosal pH levels, and was validated by experimental electrophoretic measurements and envelope protein binding assays. We have recently augmented this approach using a unique combination of protein dynamical modeling, parallel computation, and data compression tools which enable high-throughput calculations. The resulting fully-automated pipeline was capable of predicting pH sensitivity for a recent study involving more than 250 unique HIV envelopes utilizing approximately 1 million individual electrostatic surface calculations. We utilize the results to predict highly transmissible HIV variants with implications for vaccine design and efficacy.

## I Was in Great Perplexity: An Electroencephalographic Investigation of Meaning Threat

Christof Fehrman, Graduate student, Psychology; Micah D'Archangel, Graduate student, Psychology; Cyrille Magne, Faculty, Psychology; William Langston, Faculty, Psychology; William Langston (Faculty sponsor) Psychology

Meaning Maintenance Model predicts that violations in meaning can result in the affirmation of alternative or novel meaning frameworks. These violations, known as meaning threats, often occur unconsciously yet have been shown to significantly influence cognition. An increased ability to learn an artificial grammar when exposed to meaning threat has been reported as well as a polarization of beliefs in social justice and pacifism. Several different stimuli have been found to cause meaning threat behavior: anomalous playing cards, absurdist literature by Kafka, films by David Lynch, and the unconscious switching of experimenters half-way through a study. However, no studies have attempted to measure the neurological effects of meaning threats. Using the N400 event-related potential as a "window into the neurobiology of meaning," this study examined the change in N400 amplitude due to meaning threat. Participants were asked to complete a word relatedness task for baseline measurement then given one of two stories. For the manipulation group, participants were given Franz Kafka's "The Country Dentist," while a rewritten version of the story that more closely matches the typical flow of short stories was given to the control condition. Immediately after reading, participants were then given another word relatedness task to complete. N400 amplitudes were compared across condition as well as source localization techniques to examine where on the cerebral cortex the most significant changes occurred.

A Genetic Screen for Bioluminescence Genes in the Fungus *Armillaria mellea*, through the Use of *Agrobacterium tumefaciens*-Mediated Random Insertional Mutagenesis

Virginia Poole, Graduate student, Biology; J. Brian Robertson, Faculty, Biology; Kendra Baumgartner (Community member), USDA-ARS; Sarah Bergemann (Faculty sponsor) Biology

Bioluminescence is reported from 71 saprobic species of fungi from four, distant lineages in the order Agaricales. Analyses of the fungal luminescent chemistry shows that all four lineages share a functionally conserved substrate and luciferase, indicating that the bioluminescent pathway is likely conserved throughout Basidiomycota; however, the genes encoding for bioluminescence are unknown. *Armillaria mellea* is an ideal candidate for bioluminescence research because it luminesces at a high, consistent magnitude, fruits *in vitro*, and mycelia and basidiospores can be easily transformed with foreign DNA. Transformations are achieved using *Agrobacterium*-mediated insertional mutagenesis to randomly transfer an engineered Ti plasmid (T-DNA) with a hygromycin resistance selective marker into the genome of haploid *A. mellea* basidiospores. Isolates are cultured on 1% MEA+hygromycin and screened for luminescence to identify *A. mellea* transformants that lack the luminescent phenotype. To date, approximately one hundred fifty *A. mellea* transformants have been screened for luminescence and a single haploid isolate lacking the luminescent phenotype was identified. The goal of the study is to characterize the genes involved in fungal bioluminescence, and to understand the origin and evolution of this physiological mechanism in the Agaricales.

Rage and Resentment in Middle-earth: The Political Conflict of Ancient and Modern in J.R.R. Tolkien

Dennis Wise, Graduate student, English; Becky King (Faculty sponsor) English

Fantasy literature and J.R.R. Tolkien, author of *The Lord of the Rings*, offer a mode of literature uniquely suited to examining the conflict between “the ancient and the modern”—a central theme in the political philosophy of Leo Strauss. Using a Straussian lens, I look at the major work of J.R.R. Tolkien in order to uncover issues related to this conflict, particularly ideas on democracy, aristocracy, natural right, and *thumos*, a psychological principle common within ancient literature and philosophy but almost entirely neglected within contemporary discourse. As Plato describes it, *thumos*—often translated as rage, pride, heart, or spiritedness—guides the warrior class. It equates to the conventional morality of the ancient Greeks, of doing evil to enemies and good to friends, and it offers a regulatory ideal of the “fine and noble” that fits certain types of individuals (such as the warrior, the saint, the merchant) to different regimes. Prior literary critics on fantasy and Tolkien both, however, have not discussed issues of *thumos* or other issues relating to Strauss’s theme of ancient and modern. I seek to fill this gap through an analysis of *The Lord of the Rings*, fantasy literature’s most definitive work.

Tolkien’s pre-modern historical and literary research made him particularly sensitive to how *thumos* operates in political life, and he incorporates these insights into Middle-earth. As a Christian, though, Tolkien treated the *thumos* with remarkable ambivalence. He constantly sought to devalue *thumos* even while keeping the concept alive. I suggest that, while the figure of Saruman offers a trenchant critique and analysis of *thumos*, particularly in its modern manifestations, Tolkien’s negative treatment of Boromir indicates that he had a more difficult time evaluating the positive—and necessary—contributions made by *thumos* to political society.

### Terahertz Measurement of 3-D Printed Meta-material Structure

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

We present current and planned experiments and simulations on terahertz (THz) transmission characteristics of 3-D printed meta-material structures using time-domain spectroscopy (TDS) techniques. A 3-D printer is used to produce sub-terahertz-wavelength periodically patterned structures known as meta-materials that produces exotic electromagnetic behavior. The air-coupled THz measurement system utilizes a femtosecond laser pulses (centered at 780 nm) and photoconductive antennas to measure the transmission and reflection of these samples. We can characterize the refractive index and loss of samples by dividing the complex Fourier spectra of a sample signal and a reference time signal (without a sample). The magnitude and phase of the divided frequency spectra are related to the loss factor and refractive index respectively. The terahertz frequency region is also suitable to identify and characterize vibrational modes of systems such as biological tissues, active pharmaceutical ingredients, and explosives.

## Mixing Like a Producer: Creative Approaches for Mixing Contemporary Popular Music

Natasha Branch, Graduate student, Recording Industry; John Merchant (Faculty sponsor)  
Recording Industry

Despite common perception, superlative mix engineers are more than balancing technicians. While mixers are often required to compensate for sonic deficiencies, technical brilliance is secondary to creative vision. Though methodology varies, effective mixers endeavor to support each production through embellishment and—when appropriate—restraint. How do established mix engineers regard their roles in shaping productions? How does one establish creative liberty on a project produced by a third-party? What lasting techniques do they utilize in an industry of ever-changing technology? The presentation includes an historical exploration of the mix engineer's evolving role in music creation, an explanation of the most common characteristics of compelling productions, and an examination of approaches utilized in multiple contemporary hits. Furthermore, newly conducted interviews reveal the creative philosophies of several established mixers, including Grammy-winning engineers Andrew Scheps, Ed Cherney, and John Paterno. Finally, accompanying video tutorials further illuminate various creative techniques utilized by modern mix engineers.

## Using Data Preprocessing in Machine Learning to Enable Performance Gains in Classification Algorithms

Arthur Williams, Graduate student, Computer Science; Joshua Phillips (Faculty sponsor)  
Computer Science

Data preprocessing is an important step that occurs right before the data is sent to a machine learning algorithm for further processing. It involves taking data in its raw form as an input and delivering as output a new dataset, one with improved quality, that can be then be further processed by a machine learning algorithm. The method proposed by Iliou et al. seeks to reduce the dimensionality of the dataset while creating a new set of features that are more relevant to the predictor class. Principal component analysis (PCA) is another preprocessing method that looks to reduce the dimensionality of the dataset. It is also one of the most commonly used preprocessing methods for feature extraction. We intend on implementing the proposed preprocessing algorithm and testing it on three new data sets from the UCI repository. The Principal Component Analysis (PCA) method for preprocessing will also be tested against these three datasets in order to compare and contrast against the proposed method. Also, both methods will be evaluated against the K-nearest Neighbor and Logistic Regression classification algorithms. It is our goal to evaluate the performance of both Iliou's proposed algorithm and the PCA method using new datasets. The implementation of the PCA method and Iliou's method are programmed in Python 3 using functions provided by the scikit-learn library. The Logistic Regression and K-Nearest Neighbor classification algorithms were also implemented in Python 3 using the scikit-learn library. The scikit-learn library also contained functions which allowed for us to compute AUC, recall, and precision for each method per classification algorithm. These statistics will be used to provide a performance comparison amongst the two methods. In our results, we expect to show that Iliou's proposed algorithm noticeably improved the performance of each classification algorithm tested.



## Language Policies and the Impact on English Language Learners' Academic Literacy in the U.S. South

Katie Myers, Graduate student, Literacy Studies; Mohammed Albakry, Faculty, English;  
Mohammed Albakry (Faculty sponsor) English

According to the latest statistics of the U.S. Census Bureau, the southern region of the U.S. has more recently become a prime destination for immigration and has shown the highest percentage change in foreign-born population. It is important for policy makers and educators, therefore, to study the language-in-education policies aimed at improving the literacy level of English language learners (ELLs) in the southern states. Focusing on the twelve states that comprise the U.S. South, this presentation investigates whether the restrictiveness or lack thereof of the educational policy could be correlated with the academic attainment of their ELL students. Scores at both the state and national levels for ELL students in elementary school—as reported on the State Testing Score Reports (STSR) and the National Assessment of Educational Progress (NAEP)—were examined and compared. Language-in-education policies supportive of using students' home language were categorized as less restrictive or more pluralistic than policies that emphasize English-Only as the medium of instruction. Results reveal major discrepancies between state self-reporting and national assessment reporting concerning measurement of ELLs' academic language achievement. The results also indicate that a higher percentage of monitored ELL students in the states with less restrictive language policies score at or above the proficient level in reading.

## A Comparative Assessment of Standlee Premium Western Forage Timothy™ Hay Versus Locally Sourced Grass Hay Using Nutrient Composition, Glucose and Insulin Response, and Palatability

Robyn Stewart, Graduate student, Agribusiness and Agriscience; Robert Jacobs, Industry collaborator, Agribusiness and Agriscience; Michael Jerina, Industry collaborator, Agribusiness and Agriscience; Steven Duren, Industry collaborator, Agribusiness and Agriscience; Mary Gordon, Industry collaborator, Agribusiness and Agriscience; Rhonda Hoffman (Faculty sponsor) Agribusiness and Agriscience

Quality and nutritional content of forage, which is the primary component of equine diets, varies significantly due to species, maturity, and growing conditions. The objective of this study was to prove the hypotheses that Standlee Premium Western Forage Timothy™ Hay (SPWFT) has a better and more consistent nutritional profile than a locally sourced Missouri grass hay, is preferred by horses in palatability compared to local hay, and has a lower glucose/insulin response to feeding. Ten geldings received either local hay or SPWFT in a randomized crossover design for one week with a washout period between treatments during which they were acclimated to the new forage. Glucose and insulin samples were taken via jugular catheter. Baseline samples were collected at the time of feeding and every 30 min for a total of 360 min. Samples were stored for glucose analysis via absorbance values by COBAS and insulin analysis via colorimetric ELISA. Palatability and intake data were collected Wednesday through Friday of each week via a proprietary scale system for 4 h post feeding. Forages were analyzed for nutrient content and consistency. Data were analyzed using a mixed model procedure in SAS 9.4 with significance considered at  $P < 0.05$ . The SPWFT had higher DE, RFV, and WSC, while local hay had higher ADF, NDF, and lignin. SPWFT fed horses consumed their ration faster than locally sourced grass hay fed horses. SPWFT resulted in a greater area under the curve for glucose and insulin response than did locally sourced grass hay. These data demonstrate that SPWFT had a better and more consistent nutritional profile than local hay, resulted in a more pronounced glucose and insulin response to feeding, and was preferred by horses in palatability and intake trials.

## Disjunctive Dimensional Encodings for Machine Learning Tasks

Michael Jovanovich, Graduate student, Computer Science; Joshua Phillips, Faculty, Computer Science; Joshua Phillips (Faculty sponsor) Computer Science

Matrix style encodings of distributed representations are often used to encode task information prior to processing by machine learning techniques (*e.g.* neural networks or clustering algorithms). Many of the drawbacks with these representations can be avoided by instead using real valued (non-boolean) sparsely encoded vectors. In particular, relationships between concepts can be represented without an increase in dimensionality via circular convolution and addition operations. In this study, we propose a scheme which we call "disjunctive dimensional encoding" (DDE) that aims to incorporate dimensional information by adding together a component vector representing dimension with another representing feature. In this way, distinct features that share a common dimension have some level of similarity. This similarity is expected to allow for faster learning in machine learning scenarios where dimensional attention is critical to task performance, and to allow for generalization when a trained model is presented with features that are dimensionally similar to those of the training set. To test this, we will use DDEs within a temporal difference learning model to solve several variants of the Wisconsin Card Sorting Task (WCST) in which either a particular feature or a particular dimension determines reward. Training times for a single dimension and a single feature task, average task learning time when task switching is introduced, and accuracy of the trained model against novel tasks will be examined. We expect that a model that uses DDEs will require less trials to learn dimensional rules for the WCST, and will respond faster on average to task changes when compared to a model that encodes only feature information. We also expect that the model will make correct choices when presented with novel WCST tasks after being trained on a set of similar tasks.

### Validity of a Sedentary Behavior Guideline for Youth

Seungho Ryu, Graduate student, Health and Human Performance; Hoentae Kim, Graduate student, Health and Human Performance; Junbae Mun, Graduate student, Health and Human Performance; Minsoo Kang, Faculty, Health and Human Performance; Minsoo Kang (Faculty sponsor) Health and Human Performance

The Canada research group provided SB guideline that is no more than 2 hours of SB per day. The SB guideline indicated lower levels of SB are associated with higher level of fitness. Little is known about the validity of the SB guideline. The purpose of this study is to examine the validity of Canada sedentary behavior guideline for Youth. Data from NHANES National Youth Fitness Survey (NNYFS) 2012 were analyzed for this study. A total of 432 participants (221 males) aged 12-15 years completed the survey and a physical fitness examination. The NNYFS questionnaire included two questions regarding recreational SB; in the past 30 days how many hours of TV or videos were watched and how many hours of computer use. Recreation SB was categorized in two levels: (1) 2 hours and less per day; (2) more than 2 hours per day. Health related fitness consisted of body composition, muscular strength and cardiorespiratory fitness. Body composition was measured by BMI, muscular strength was measured by plank, and cardiorespiratory was measured by VO<sub>2</sub>max in NNYFS examination. To validate SB guideline, the general linear model was used to examine the association between the recreational SB and health related fitness after controlling the covariates (*i.e.*, age, gender, and physical activity). After adjusting the covariates, recreational SB was related to plank,  $F(1, 427) = 4.14$ ,  $p = .043$ . Recreational SB, however, was not related to VO<sub>2</sub>max and BMI,  $F(1, 427) = 1.62$ ,  $p = .20$  and  $F(1, 427) = 0.67$ ,  $p = .413$ , respectively. Recreational SB was only associated with muscular strength. The lack of validity for the SB guideline may be due to surrogate measure of SB used in the current study. Further validity research is needed using more accurate measure of SB.

## A Validity and Reliability Study of an Adolescent Fruit and Vegetable Consumption Barrier Scale

Sarah Murfree, Graduate student, Health and Human Performance; Tracy Noerper, Graduate student, Health and Human Performance/Lecturer, Human Sciences; Norman Weatherby (Faculty sponsor) Health and Human Performance

Most adolescents do not consume the recommended amount of fruits and vegetables. An improved understanding of barriers to fruit and vegetable consumption could improve health education programs aimed at reducing barriers to increase fruit and vegetable consumption in adolescents. The National Cancer Institute's FLASHE Adolescent Diet Survey includes a section with five items related to barriers. The purpose of this study is to establish validity and reliability evidence for this barrier scale. Validity is defined as the extent to which the survey measures what it intends to measure. Reliability is defined as the extent to which the survey consistently produces accurate results. The data used in this study is from the 2014 FLASHE survey completed by a nationally representative sample of 1,541 participants age 12 to 17.

The Rasch analysis uses Item Response Theory to establish reliability by analyzing the survey participants' ability level in relation to the survey items results. The results of this Rasch analysis indicate the barriers described in five survey questions were easily overcome by the survey participants. There may be other barriers to fruit and vegetable consumption in adolescents not included in these five items.

Convergent validity compares the results of survey items measuring the same traits. FLASHE survey items measuring self-efficacy, social norms, and actual reported consumption of fruits and vegetables were correlated to the results of the barrier items. The correlations provided evidence of convergent validity but only at a low association level.

This validity and reliability study indicates additional items related to barriers to fruit and vegetable consumption are needed to better distinguish adolescents with high levels of barriers from adolescents with low levels of barriers to fruit and vegetable consumption.

## Humps in Higher Education Expenditure Over the Life-Cycle: Facts From Consumer Expenditure Survey Data

Abul Hasnat Salimullah, Graduate student, Economics and Finance; Stuart Fowler (Faculty sponsor) Economics and Finance

This paper uses Consumer Expenditure Survey (CEX) data and a Correlated Random Effects (CRE) regression model to estimate the effects of individual age on higher education expenditures. A pseudo panel or synthetic panel has been constructed due to the incompatibility of forming the regular panel associated with the CEX data, and a range of cohorts have been used as the fixed effects. Controlling for different demographic level characteristics, the regression results are then used to construct the life-cycle profile for higher education expenditures based on age. The estimated coefficients of age and its polynomials are found statistically highly significant. For the case of demographic variables, the coefficient estimate of race demonstrates that white individuals residing in urban areas have a larger mean value for the higher education expenditures as compared to the non-white and rural residents. Special emphasis is placed on finding the turning points by using the polynomial regression coefficients that indicate a change in the age pattern over the life-cycle. The estimation result claims a “hump” shape nature for education expenditures, counter to what theory suggests.

## Airport Analysis from a Safety Perspective: North American Airports vs European Airports

Olga Garcia Alvarez, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor) Engineering Technology

After different terrorist attacks, the safety in airports has been questioned. Even though the chance of a flight accident is very low, the safety risks around airports are larger than people expect. Europe and North America have the world's busiest airports where several ways of improvement the safety issue might be used with excellent results for future air travel experiences.

The primary objective of this analysis is to find the difference between North American and European airports from a safety perspective. The design, layout or even technologies are completely unlike. They have been using this system for decades in order to fill up their requirements and needs. However, there are some recommendations for each one of them that can make the experience for passengers better.

## Virtual Reality Audio: Experiencing the Recording Studio

Mark Kendree, Graduate student, Recording Industry; Matt Foglia (Faculty sponsor) Recording Industry

The purpose of this project is to research interactive virtual reality audio recording techniques and their possible implementations into the game development engine, Unity. To enhance this experience, the audio middleware program FMOD will be used to manage audio assets. Research for this project includes a study of methods used to record audio for virtual reality purposes. Another focus of research will be methods and practices used by sound designers to create a realistic audio experience within a virtual reality video game context.

The deliverable for this project will be an executable program file for the Windows operating system paired with an Oculus Rift headset, an Xbox 360 controller, and a pair of headphones. The program will be a virtual reality recreation of MTSU's Recording Studio A. Within the program, the studio will contain an "interactive band" with members that respond to input by the user. With the band playing, the user will then be able to explore the room and experience how certain instruments sound within the recording studio space. Sound designers, audio engineers, or anyone with a desire to learn about audio within a virtual reality video game should find interest in this project.



### Analyzing Growth and Change Between ELL and non-ELL Examinees: Latent Growth Curve Modeling Applied to Reading Comprehension Test

Daren Li, Graduate student, Literacy Studies; Jwa Kim, Faculty, Literacy Studies; Zaya Ahmed, Graduate student, Literacy Studies; Jwa Kim (Faculty sponsor) Literacy Studies

Latent growth modeling (LGM) is a powerful approach to the description, measurement, and analysis of longitudinal changes. In this study, reading comprehension test data were obtained from the 9th grade students at 3 time points. The LGM analysis enables accurate determination of the trajectory for each individual and inter-individual difference in their reading comprehension performance changes. The role of English language learners (ELLs) status in students' reading comprehension has been extensively studied in educational fields. This study provides us a simple LGC modeling to investigate the latent growth curve changes between ELLs and native English speakers (non-ELLs). The results indicated that LGC modeling provided a good model-data fit through a chi-square test and other model data fit indices. The standardized LGC diagram provided further information that ELL status impacted the initial levels of comprehension scores but not the slope. The gap of comprehension proficiency between ELLs and non-ELLs has no dramatic change at any point based on the correlation between initial levels of comprehension and slope. The results were interpreted along with the previous findings from Lesaux et.al (2010) and Kieffer and Box (2013) that reading comprehension performance of language minority learners tends to lag well behind than that of their English native speakers in all content areas due to English comprehension proficiency appears to dominate all aspects of curriculum with increasing years of schooling. In order to obtain accurate description of reading comprehension discrepancy between ELLs and non-ELLs, further studies may investigate the effects of other variables including ELL students' first language (L1) skills, language components of comprehension as well as psychometric analyses for test items.

### Online Meat Delivery Service

Fahd Aljohani, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)  
Engineering Technology

This project will study the market of the sheep and goats in Saudi Arabia, which is very important in the culture. Currently, people must go to a shop to look for the perfect animal they want for the meat, which can be a long, hot and smelly process. My project will be an online-based business so people never have to go to the slaughterhouse. They will instead go to my website and look up the goat and sheep which will be at a farm we work with near them. We will pick up their meat at the farm, slaughter and prepare it the way they want, and then deliver the meat to our customers. There are three types of people who will find this process especially convenient who I will target for my new business. First, it will be very helpful for people who had no experience in selecting the sheep and goats before. Next, it will be very suitable for people who prefer to pay more, but receive more comfort. Finally, it would be very convenient for women, who would not have to spend hours in the kitchen cleaning and cooking enormously big size meat. I will use the project to research how my business will truly succeed in my country and benefit the customers who use my business.

### Incorporation of Ag<sup>+</sup> into PbS Quantum Dots by Cation Exchange

Alexander Morris, Graduate student, Chemistry; Ronald Higdon, Undergraduate student, Chemistry; Ryan Tilluck, Undergraduate student, Chemistry; Gregory Van Patten, Faculty, Chemistry; Gregory Van Patten (Faculty sponsor) Chemistry

Cation exchange provides a method for producing new quantum dot (QD) materials that are otherwise difficult to produce. In PbS QDs, cation exchange has thus far been limited to Cd ions, require high temperatures and an inert atmosphere. We report here an approach that yields access to Ag/PbS QD heterostructures starting from PbS using a novel Ag<sup>+</sup> complex under ambient conditions. Various Ag<sup>+</sup>: Pb<sup>2+</sup> reaction ratios have been studied resulting in controlled partial and complete exchange. The exchange is found to occur rapidly and completely, due to the Ag<sup>+</sup> ion being highly mobile in crystals. This is evidenced by the shrinking and eventual disappearance of the characteristic PbS QD absorbance peak and elemental analysis showing increased incorporation of Ag<sup>+</sup> via XRF and STEM EDS mapping. The preservation of QD structures was evidenced by TEM images. The change in crystal structure from PbS to Ag<sub>2</sub>S was evidenced by FFT and XRD spectra.

## Production of Secondary Metabolites from Industrial Hemp (*Cannabis sativa L.*) via Plant Tissue Culture Systems

Matthew Fuller, Graduate student, Professional Science; Shannon Smith, Graduate student, Molecular Biosciences; Clint Palmer, Graduate student, Molecular Biosciences; Kayla Thomas, Undergraduate student, Biology; Xoe Thacker, Undergraduate student, Biology; Elliot Altman, Faculty, Biology; John DuBois (Faculty sponsor) Biology

Industrial hemp (*Cannabis sativa L.*) is a herbaceous plant that has historically been grown for fiber and oil production. Several bioactive non-psychotropic secondary metabolites produced by industrial hemp have been described to possess pharmacological benefits, including promising anticancer and anti-inflammatory effects. As such, there exists a demand for the mass production of these compounds in a controlled and scalable manner. Plant tissue culture is a unique way of producing large amounts of biomass in a controlled setting, and can be optimized to grow special tissue types (such as roots, embryos, or trichomes). Our lab is focused on the production of non-psychotropic secondary metabolites from industrial hemp via plant tissue culture, and is approaching this goal through various routes. Some of the ongoing projects include initiating trichome structures from plant callus and the use of plant elicitor compounds to stimulate the production of the compounds of interest. In order to optimize these tissue culture efforts, work is also underway to experimentally determine the culture requirements for different cultivars of industrial hemp. By screening a selection of industrially-relevant cultivars on media types with various ratios of plant growth regulators, vitamins, and media amendments, we can experimentally determine a media formulation that is optimized for pharmaceutically-valuable cultivars of industrial hemp. Future work in the hemp project will involve breeding studies and the use of bioassays to determine effects on cancer and the immune system.

## 2017 MTSU Solar Boat

Syed Bukhari, Graduate student, Professional Science; Joel Clements, Graduate student, Professional Science; Dayana Priyanka Bernadsha Thana Edison, Graduate student, Professional Science; Saeed Foroudastan (Faculty sponsor) Engineering Technology

Middle Tennessee State University's Experimental Vehicles Program (EVP) has vastly being recognized and appreciated in industry and in student community. The program provides students an opportunity to improve their technical skills, time management skills, and team work. Experimental Vehicles Program currently execute three major research projects 1. Solar Boat 2. Baja. and 3. NASA Human Exploration Vehicle (Moon buggy). Students working on these projects get hands on experience of using machine and hand held tools, students also get a chance to polish their theoretical knowledge that they gain in class room. The Solar boat has vastly improvised over the past years in utilization of solar energy and to implement green energy agenda. The Solar Boat project is sponsored by American Society of Mechanical Engineers (ASME), the Solar Boat goes into world championship every year and currently holding 2nd position in the world. The Solar Boat was designed and built by students to promote clean energy needs and to compete in the world championship as well. Talented students built the hull with carbon fiber, drive train features an Arneson-type out Drive with an electric actuator for trimming. The boat is equipped with two solar panels that charge the batteries and provide energy to run the boat at moderate speeds for a considerable time period.

DC motors provide energy to the drive train. The students integrated a telemetry system that stays out side of the boat or on shore and tracks the route up to two miles while the boat is on the water. Use of the remote telemetry system allows the user to monitor and control system voltage, current draw, and video data.

## The Distribution and Prevalence of the Plant Pathogen, *Armillaria mellea* in Eastern North America

Bryce Kerr, Graduate student, Biology; Sarah Bergemann, Faculty, Biology; Sarah Bergemann (Faculty sponsor) Biology

Many natural forests are threatened with the increasing spread of fungal plant pathogens. *Armillaria mellea* (Physalacriaceae, Basidiomycota) is a generalist pathogen infecting many woody crops, ornamental plants and forest trees. In eastern North America, *A. mellea* acts as an opportunistic pathogen that infects mostly hardwood tree species. The aim of this study is to predict the distribution and the risk of invasion of *A. mellea* in eastern North America using environmental niche modeling. The identities of the selected specimens were verified through phylogenetic analyses using two partial sequences nuclear loci: translation elongation factor subunit 1-alpha (*tef1*) and the genes that encodes for the actin subunit (ACTIN). The locale data of *A. mellea* along with several environmental layers will be analyzed using Maxent which uses a maximum entropy approach to determine the probability of *A. mellea* occurrence for each 200 m<sup>2</sup> grids. Our preliminary species distribution map reveals a climatic distribution along a latitudinal gradient extending from 33.56° to 48.05° and a longitudinal distribution from -64.41° to -91.12° but lacks high prevalence in the southeast Gulf States which may be due to a model bias from the lack of locale data in the region or environmental determinants that limit the distribution.

## MicroRNAs May Drive Variations in Muscle Growth and Quality Traits in Rainbow Trout

Bam Paneru, Graduate student, Molecular Biosciences; Rafet Al-Tobasei, Graduate student, Computational Science; Brett Kenney, Non-MTSU university faculty collaborator, ; Timothy Leeds, Government agency collaborator, ; Mohamed Salem (Faculty sponsor) Biology

To investigate the role of microRNAs in muscle gene regulation, RNA-Seq was used to identify differential expression in microRNAs and single nucleotide polymorphisms (SNPs) in microRNA target sites associated with 5 fish/muscle growth and quality traits: whole body weight (WBW), muscle yield, muscle crude-fat content, muscle shear force and whiteness. Phenotypic data were collected from ~500 fish, representing 98 families (5 fish/family), from USDA growth-selected line. Muscle microRNAs and mRNAs were sequenced from 22 families showing divergent phenotypes. Ninety microRNAs were differentially expressed (DE) between high- and low-ranked families. Expression of 12 DE microRNAs chosen for 'genotype-phenotype' association explained 31%, 42%, 22%, 13% and 26% variation in WBW, muscle yield, crude-fat, shear force and fillet whiteness respectively. DE microRNAs and target genes showed correlated expression and shared cis-regulatory promoter motifs for the same transcription factors suggesting transcriptional co-regulation of microRNAs and target genes. A total of 243 SNPs showing allelic-imbalance between low- and high-ranked families either destroyed or created novel illegitimate microRNA target sites in muscle-important genes including MEF2C. These findings suggest an essential role of microRNA in regulating muscle growth and fillet quality in rainbow trout. Additionally, genetic variation at microRNA targets will help develop genetic markers for selection.

### Is Shared or Formal Leadership Effective in Guiding Aerospace Teams to Financial Success?

Megan Snodgrass, Graduate student, Psychology; Jessi Pope, Graduate student, Psychology; Megan Wertheimer, Graduate student, Psychology; Ryan Bearden, Undergraduate student, Psychology; Glenn Littlepage (Faculty sponsor) Psychology

Research exploring the influence of leadership on team performance has revealed certain leader behaviors can impact team effectiveness (Burke *et al.*, 2006; Chidester, Helmreich, Gregorich, & Geis, 1991; Yukl, 2012). This is especially relevant for jobs that require high levels of collaboration among team members, and thus this research is very important for those that manage and work in these types of jobs. The Flight Operations Center – Unified Simulation (FOCUS) Lab at Middle Tennessee State University replicates a high-fidelity flight operations center where team members work together to operate a virtual airline. Effective leadership within each FOCUS Lab team is necessary for operations to run smoothly. The formal leadership of the Flight Operations Coordinator (FOC) is displayed through communication and decision making that directly impacts the performance of the team. The purpose of this research is to evaluate the relative impact of leader behaviors on team outcomes in the context of a student-lead flight operations center. FOC and shared team leader behavior scores are expected to relate to team performance. Three measures of leader behaviors (*i.e.*, person-oriented, task-oriented, and transformational leadership) demonstrated by the FOC and the overall team will be examined in relation to performance criteria (*i.e.*, financial data including flight delays and penalties; N = 300 participants, 29 teams).



## Building Mathematical Knowledge for Teaching in a Geometry Content Course for Preservice Secondary Teachers

Lucy Watson, Graduate student, Mathematics and Science Education; Candice Quinn, Graduate student, Mathematics and Science Education; Alyson Lischka, Faculty, Mathematics; Jeremy Strayer, Faculty, Mathematics; Alyson Lischka (Faculty sponsor) Mathematics

To address the need for increased quality of teacher preparation programs, this study focused on the development of mathematical knowledge for teaching (MKT) during a College Geometry course for preservice secondary mathematics teachers (PSMTs).

This project included developing, piloting, and studying the effectiveness of modules for use in a College Geometry course that interweaves common and specialized content knowledge elements into a content course for PSMTs. PSMTs engaged in mathematical practices while developing a deep understanding of advanced content through three modules.

One question guided the study: How does the PSMTs' MKT change as a result of interacting with the Geometry Modules? The collected qualitative data included a pre- and post-assessment that required PSMTs to respond to student thinking using a representation of teaching practice. PSMTs responded to a pre-assessment on geometric knowledge necessary for teaching. Then, following the teaching of an advanced topic, PSMTs drew on their own understanding, and responded to post- assessments of the geometric knowledge PSMTs believed necessary for teaching at the secondary level. PSMTs took the nationally validated Mathematical Knowledge for Teaching Geometry Assessment (1) as a pre- and post-assessment of the course. Preliminary findings indicated that PSMTs moved from generalized discussion of student thinking to more specific responses that indicated application of MKT. This poster will include an overview of the project and how it began, a brief description of the modules and how they help develop PSMTs' MKT, a description of data collected, and a review of initial findings and next steps.

1. Mohr-Schroeder, M. J., Ronau, R., N., Peters, S., Lee, C. W., & Bush, W. (accepted). Knowledge for teaching geometry: Predicting student achievement from teacher measures.

## The Pathogenic Yeast, *Cryptococcus neoformans*, Alters the Transcriptome of Infected Macrophages

Linda Sircy, Graduate student, Biology; Kirsten Cunningham, Undergraduate student, Chemistry; Erin McClelland, Faculty, Biology; David Nelson, Faculty, Biology; David Nelson (Faculty sponsor) Biology

*Cryptococcus neoformans* (*Cn*) is a ubiquitous fungal pathogen that is a leading cause of mortality among the immunocompromised with almost 625,000 deaths per year worldwide, predominantly affecting regions with a high prevalence of HIV/AIDS. *Cn* infections usually begin as acute pulmonary infections that can progress to fungal meningitis, but *Cn* can also establish long-lasting chronic infections by residence inside host macrophages and re-emerge decades later. However, the mechanisms *Cn* utilizes to avoid destruction by host macrophages are poorly understood. One strategy that some intracellular pathogens use to attenuate the innate immune response is the inhibition of host cell protein synthesis. Previous studies have shown that intracellular *Cn* can partially inhibit nascent protein synthesis, although the mechanism by which this is achieved is unclear. Another strategy employed by intracellular pathogens to avoid destruction by host macrophages is to block or attenuate classical M1 polarization. While M1 macrophages exhibit enhanced microbicidal activity and are associated with a more favorable clinical outcome in cryptococcal infections, alternatively activated (M2) macrophages are less able to destroy ingested pathogens. These two states can be distinguished by contrasting gene expression profiles with *NOS2* and *Arg1* recognized as markers of M1 and M2 macrophages, respectively. Using RNA sequencing to assess the transcriptome profile of *Cn*-infected macrophages, our data suggests that intracellular *Cn* causes down-regulation of ribosomal and mitochondrial oxidative phosphorylation genes, which are possible causes of the observed inhibition of host cell translation and mitochondrial dysfunction. Additionally, our data suggests that intracellular *Cn* pushes M1-polarized macrophages towards the M2 state, as *Arg1* and the M2-exclusive marker genes, *Egr2* and *Myc*, were up-regulated after 24 hours of infection. Therefore, our data suggest that intracellular *Cn* alters macrophage function through changes at the transcriptional level.

### Phenotypic Testing of the RTA1 gene in *Cryptococcus neoformans* through creation of Knockout and Reconstituted Strains

Emily Smith, Graduate student, Biology; Ronakkumar Patel, Graduate student, Biology; Erin McClelland (Faculty sponsor) Biology

*Cryptococcus neoformans* is a yeast-like fungal pathogen with a capsule that is known to cause meningoencephalitis and occurs primarily in immunocompromised patients such as those suffering from HIV. Researchers are working on how *C. neoformans* causes disease in humans and the RTA1 gene has been identified as a potential factor that affects virulence. A knockout strain (*rta1* $\Delta$ ) was created and shows a marked increase in sensitivity to 7-amino cholesterol, a longer doubling time, more capsule released into the host cell, and lower urease production. The knockout strain was created through overlap PCR, biolistic transformation, screening on YPD plates and Southern blot analysis. Currently, work is being done to create a reconstituted strain (*rta1* $\Delta$ +RTA1) to ensure differences in virulence seen in *rta1* $\Delta$  are solely due to knockout of the target gene. A construct to be used for transformation has been created through cloning of three pieces of DNA: the 5' UTR and RTA1, a Neomycin resistance marker, and 3' region downstream of RTA1 into the pAllet plasmid. Confirmation was completed through colony PCR and sequencing. We are currently in the process of transforming the created construct back into the *rta1* $\Delta$  strain two independent times using biolistic transformation. Transformants will then be screened by PCR analysis and Southern blot to ensure homologous recombination occurred. We will then repeat the initial experiments with both the *rta1* $\Delta$  and the *rta1* $\Delta$ +RTA1 strains testing for differences in capsule shedding, doubling time, melanin production, phospholipase production, and resistance to 7-amino cholesterol. We expect the reconstituted strains to have a phenotype similar to that of the wild type and expect to see the same differences in factors contributing to virulence in the *rta1* $\Delta$  strain as seen in initial testing.

## Cell Formation Problem Using Artificial Neural Networks and Simulated Annealing

Aishah Alamri, Graduate student, Computer Science; Joshua Phillips (Faculty sponsor)  
Computer Science

Cellular manufacturing systems are a form of group technology wherein various machines or processes have been combined into cells, each of which is devoted to the fabrication of a part, product family, or finite group of families. Cell formation is necessary for implementation of cellular manufacturing. Many computational methods exist for solving the cell formation problem. Some of these methods include stratification in traditional cell design, fixed routines or dynamic cell environments. Neural networks may be viewed as formal models of cognitive processes or as a model of how the brain works. Today, neural network methods are being used to solve many problems associated with manufacturing operations. In this research, the fractional cell formation problem is solved by using a modified adaptive resonance theory1 (ART1) network. The input to the modified ART1 is machine-part incidence matrix comprised of the binary digits 0 and 1. This method is applied to benchmark problems found in the literature and it is found to be equal or superior to other algorithms in terms of minimizing the number of exceptional elements. The relative merits of using this technique with respect to other known algorithms/heuristics in terms of computational speed and consistency are presented. It was found that the modified ART1 solution is superior in most of the cases.

## Runway Camera as an Operations Counter and Recorder

Vinay Kumar Vushagani, Graduate student, Aerospace; Nate Callender (Faculty sponsor)  
Aerospace

Aircraft activity information at an airport is the key element to operators, airport owner and airport designers. The accurate information about the aircraft operations at the airport is helpful in design and development, planning and implementation, and administering these facilities. While the air traffic control tower department is responsible to monitor, and record the aircraft activities at an airport, it is highly difficult for the airports which do not have a control tower. This is the major problem for many smaller general aviation airports. Many methods have been practiced to count the operations at these airports, unfortunately it was always difficult to obtain accurate information due to several reasons. These methods include visual observations, pneumatic tube counters, inductance loop counters, and acoustical counters. These techniques are updated with the use of current technology, where cameras are mounted along with the use of sensors to detect and record the aircraft activities. The usage of cameras also advantages the safety and security aspects of the airport.

The poster will be presented on all the existing technologies to count the aircraft operations. As this is an ongoing research to determine the best possible way to count the airport operations at Murfreesboro Municipal Airport (MBT), the current feasible models to integrate to this airport runway will be included. One of the popular phrases that states “If you’ve seen one airport, then you’ve seen one airport”, so this part of the presentation will be dependent on Murfreesboro airport layout. This presentation will be helpful for all the aviation and STEM students to explore the technologies and trends followed by the aviation Industry to count their operations.

## Exploring Music Production with Three Types of Synthesis; Additive, Subtractive, and FM

Jeffery Banks, Graduate student, Recording Industry; Joseph Akins (Faculty sponsor) Recording Industry

Additive, Subtractive, and FM Synthesis are three types of synthesis for constructing sound patches in music production. The ability to create music by arranging complex waveforms built upon simpler waveforms has become a modern day musical practice. My presentation outlines the sonic differences between synthesis types and the process of crafting sounds within these synthesis types.

The first half of my research summarizes my understanding of each synthesis type, including audio waveform fundamentals as well as common parameters found within synthesizers. The latter portion is an in-depth analysis of six commercially produced instrumental tracks ranging in a variety of synthetic and acoustical sounds. The creative aspect engulfs the exploration of all three synthesis types at their maximum potential through the analysis and production of instrumental music. Specifically, six instrumental tracks are being constructed into an EP (Extended Play), discretely accounting for each synthesis type. All instrumentals are directly referencing the six commercial tracks stated above. The goal is to produce 'sound-alikes' while limiting my production to a single synthesis type per track. Upon completion, each instrumental will reference a commercially released track and each synthesis type will account for two instrumentals.

The presentation is geared towards people that take interest in sound creation such as foley artists, sound library developers, music producers, and casual music listeners. It provides a greater understanding of sound development in regards to producing sounds for specific genres and other audio purposes. With the creation of the EP, the project will provide a greater outlook on each synthesis type and a demo of what can be accomplished solely with each type. Lastly, a completed sound library of each digital patch used in the making of this project will also be provided.

## Overlapping-enabled Sliced Inverse Regression for Dimension Reduction

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

Advances in data collection and storage capabilities during the past decades have led to an information overload in most sciences. Researchers working in domains as diverse as engineering, astronomy, biology, remote sensing, economics, and consumer transactions, are facing larger and larger observations. The dimensionality of the data is the number of variables that are measured on each observation. High-dimensional data sets present many mathematical challenges as well as some opportunities to give rise to new theoretical developments.

Sliced inverse regression (SIR) is a statistical tool for dimension reduction. It identifies the effective dimension reduction space, which is the subspace of significant factors with intrinsic lower dimensionality. In this project, we propose refined implementations of SIR algorithm by allowing slice overlapping. The new algorithms, called overlapping-enabled sliced inverse regression (OSIR), can estimate the effective dimension reduction space and determine the number of effective factors more accurately. We show that the overlapping technique codes the information of the differences (or derivatives in the population version) of the inverse regression curve, which helps explain the superiority of OSIR. We also prove OSIR algorithms are square root of  $n$  consistent and verify the effectiveness of OSIR algorithms by simulations and applications.

## Addressing Illiteracy, Racism and Racial Homogeneity in Grundy County, TN through Library Outreach Initiatives: A Proposal

Mary C. Zeitler, Graduate student, Educational Leadership; Kathryn Boudreau-Henry (Faculty sponsor) Library

Grundy County (pop. 13,703), a rural mountain-top community in southern middle Tennessee, is a microcosm of American Appalachia and its ubiquitous stereotypes: widespread poverty and substance abuse, low high school graduation and high unemployment rates, and poor literacy rates. Additionally, Grundy County has an overwhelmingly homogenous population: 97% are white. Whether from fact or folktales, the county suffers the dubious reputation of being racially insular and resistant to change. With my research, I propose to address the following question: How might diversity awareness and acceptance in Grundy County be raised by incorporating a volunteer program that places local college students of color into community and school libraries to participate in day-to-day library work, including literacy programs and collection development?

This project will be executed in two phases: first, research into the literacy and library history and traditions of Grundy County, focusing on residents' experiences with their local and school libraries as well as an examination of the library's collections and collection development policy specifically as they relate to cultural diversity; and second, design and plan the implementation of a minimally-intrusive outreach initiative to Grundy County libraries that seeks to (a) expand literacy rates in program participants (b) increase residents' exposure to multi-cultural reading materials and library workers of different colors and ethnicities. Mutual learning and collaborative work among neighbors who are also strangers can launch refreshed perspectives about reading as community change agent.



## Binaural Recording "The Art of Human Hearing"

Eben Powell, Graduate student, Recording Industry; John Merchant (Faculty sponsor) Recording Industry

This capstone project will include three separate tasks that could be taken individually or combined as I am doing. These three components include scientific research, artistic component and a legally negotiated contract. The research component will focus on the science of human binaural hearing. I will use an industry standard binuaral head, the Neumann KU 100, and record test signals and music to advance the science of binaural recordings. Included in this research will be Head-Related-Transfer-Functions (HRTF), which is a graphical representation of a single person's hearing response. This research is applicable to stereo recordings, movies, video games and all 3D and virtual reality environments.

The artistic component will be a high-end recording project with a well-known jazz artist, Jeff Franzel from New York, and will result in a commercially viable product that will be released by the artist. The legal component will be the negotiation of a contract with the artist for the recording and release of the album. I will negotiate as the record label and producer for the project.

The artist will record an extra track for the video component to be shot using period clothes and treatments centered around the 1920's jazz scene. The video will be released on the artist's website as bonus content for his followers.

## New Trends in the Surveillance Industry: Decrypting Human Emotions

Valentin Vinca, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)  
Engineering Technology

Investing in security has become a high priority for most governments worldwide. In the last few decades more and more sophisticated surveillance cameras are using face recognition software to identify potential threats. Even if still reliable, the facial biometric techniques have proven their limitations, attributed to many variations in location, orientation, pose, scale, facial expression, occlusions, lighting conditions. The presentation intends to explore new logical steps forward for the surveillance industry by implementing software and hardware that will enable decrypting human emotions. The result will not only give the face recognition technique a higher degree of accuracy, but will create the opportunity of getting a step ahead in preventing possible threats.

### Century Farms: Loss and Preservation

Michael Bleddynn, Graduate student, Geosciences; Bethany Hall, Graduate student, Geosciences; Henrique Momm (Faculty sponsor) Geosciences

The Tennessee Century Farm Program is a documentary effort to chronicle farmland remaining within the same family for at least 100 years and which remains actively engaged in agricultural production. Since 1970, Rutherford County's population has increased from approximately 59,000 residents to more than 260,000 residents as of the 2010 census.

With this in mind, we have to ask, how has the increased demand for housing affected the large tracts of land associated with our historical farms? How much farmland have we lost to commercial housing developments?

We begin our study with the digitization of tax maps from the Rutherford County Assessor's Office obtained in the 1960s and approved in 1974. Our poster will detail the locations and size of the farms on the 1974 maps and compare the information with the modern farms. How many have we lost? How many have suffered losses in acreage? This will allow us to analyze and examine land use and expansion within Rutherford County, TN.

## Health Related Productivity Loss: Assessment of “Presenteeism” in Higher Education, Finance and Manufacturing Industries

Amber J. Dorsey, Graduate student, Health and Human Performance; Heontae Kim, Graduate student, Health and Human Performance; Marquinta L. Harvey, Graduate student, Health and Human Performance; Cynthia Bass-Thomas, Graduate student, Health and Human Performance; Andrew Owusu, Faculty, Health and Human Performance; Norman Weatherby, Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Introduction:** Societal labor standards place a premium on productivity but often neglects to explore the impact of less visible physical and psychological stressors on productivity. Although one can easily track an employee’s absences, it can be difficult to detect underlining medical conditions that may hinder a person’s work performance. Absenteeism and presentism collectively result in low productivity. Presenteeism is defined as health related on-the-job productivity loss. Limited research is available regarding assessment of presenteeism’s impact on job performance. This study investigated the influence of gender and industry type on amount of presenteeism experienced by workers.

**Methods:** The Work Limitations Questionnaire (WLQ), a self-administered survey, was used to measure the extent to which health conditions interfere with job performance. Data was gathered from 23,164 employees from 48 states in the United States from within three industry types: finance/insurance, manufacturing/warehousing, and higher education. ANOVA was used to compare group means of both genders across the three industry types. The group with the highest WLQ index score indicates the greater amount of presenteeism.

**Results:** This study showed a significant difference between gender and the three industries. The main effects for gender and industry were,  $F(1, 23158) = 18.69, p < 0.001$  and  $F(2, 23158) = 46.46, p < 0.001$  respectively. Women exhibited the greatest amount of presenteeism across the industry types (higher education > finance > manufacturing).

**Conclusion:** The implications of the data gathered from this study can influence the development of programs in higher education, tailored to meet various departmental needs for the well-being of faculty and staff. The overall work experience for the faculty and staff subsequently impacts student engagement and involvement with the collegiate environment.

## 2017 MTSU NASA Human Exploration Rover Challenge

Dayana Priyanka Bernadsha Thana Edison, Graduate student, Professional Science; Joel Clements, Graduate student, Professional Science; Syed Bukhari, Graduate student, Professional Science; Saeed Foroudastan (Faculty sponsor) Engineering Technology

MTSU's Experimental Vehicles Program (EVP) provides a student-driven, interdisciplinary, hands-on learning experience that is open to all students attending Middle Tennessee State University. Initiated in 2004, EVP is composed of three active project teams-Baja SAE, NASA Human Exploration Rover Vehicle, and Solar boat ASME which are designed, crafted, and led by students. This year the MTSU NASA teams will field two Rovers. One will be a modified award winning rover, also known as THE BEAST, and the second will be a new innovative design entry. The rover design is focused on NASA's current plans to explore planets, moons, asteroids, comets and all members of the solar system family. Rover designed at the EVP allows students to enhance technical skills, develop soft skills to develop technologies and concepts that will be needed in future exploration missions. The rover will be man powered and it would carry two students, one female and one male which will be able to run over obstacle course of simulated extraterrestrial terrain of craters, ridges, inclines, and depressions. The rover is designed best to perform in all different environments. The propulsion system which is human powered with innovative wheel technology will provide the rover with good performance, speed and ability to perform in rough terrains. Students fabricate in-house 80-90% of vehicle components.

Members are provided the opportunity to learn every aspect of product design. Rover project is tasked with development, research, design, fabrication, safety considerations, writing of technical and cost reports, business, marketing, accounting, and leadership involved in prototype vehicle design in accordance to the rules provided.

## Absurd Reality: A Behavioral Analysis of the Effect of Meaning Threat on the Interpretation of Unrelated Word Pairs

Micah D'Archangel, Graduate student, Psychology; Christof Fehrman, Graduate student, Psychology; William Langston, Faculty, Psychology; Cyrille Magne, Faculty, Psychology; William Langston (Faculty sponsor) Psychology

When situations or objects violate our expectations of the way reality is supposed to operate, certain mental processes step in to alleviate the distress. Meaning is typically thought of as mental representations of connections and relationships between concepts, such as water being wet or water being associated with rain. A violation of those sort of expectations is often referred to as simply meaning threat. Participants under a state of meaning threat are thought to go into certain mental processes in order to resolve the threat, such as becoming more rigid in their beliefs (McGregor, Zanna, Holmes, and Spencer, 2001) or creating a sense of meaning by finding patterns where none naturally exist (Proulx & Heine, 2009.) Participants were given series of words pairs which they evaluated as either “related” or “unrelated” before and after reading either a control or an absurd story by Franz Kafka. Their reaction times and accuracy were recorded and participants also answered a questionnaire consisting of the Schizotypy Personality Questionnaire - Brief, the Beck Anxiety Inventory, the Big Five Personality Inventory, and the Personal Need for Structure Scale in order to evaluate the effects of meaning threat in greater detail and investigate the supposed effects of meaning threat.

### Predicting Tickets Sales for Air Shows

Stephen Henderson, Graduate student, Mathematics; Yiting Dong, Undergraduate student, Mathematics; Don Hong (Faculty sponsor) Mathematics

Companies want to know the success of their event as their tickets are on sale. Prediction and good estimation of ticket sales will allow for companies to see if they need to plan for things such as advertisement for their event beforehand and arrangements of services for the event. The purpose of this study is to predict the ticket sales for air shows put on by a ticket-selling company. This study uses the ticket sales data of the 4 past events of the Great Tennessee Air Show. Three of the events are used as a train set, while the other event is used as a test set. The study used a timing model with a two-segment Latent Class Weibull Model on the train set. The parameters of the model were found by computing each of the maximum likelihood estimators. The results show that the first segment has a small-scale parameter and a small shape parameter. The second segment has a smaller scale parameter but has a larger shape parameter. The results of the model approach were used on the only event in the test set as well as on other previous air shows. This model will be used as a metric for predicting ticket sales on future air shows.

### Adaptable Aviation: Individual and Team Adaptive Capacity in Flight Operations Teams

Jessi Pope, Graduate student, Psychology; Dr. Glenn Littlepage, Faculty, Psychology; Glenn Littlepage (Faculty sponsor) Psychology

Based on ever-changing, dynamic, and ambiguous environments experienced by both teams and individuals in the modern workplace, being adaptive is more important than ever for both workers and teams (Huang, Ryan, Zabel, & Palmer, 2014; Pulakos, Dorsey, & White, 2006; Rosen et al., 2011). The Flight Operations Center – Unified Simulation (FOCUS) Lab at Middle Tennessee State University replicates a high-fidelity flight operations center where team members work together to operate a virtual airline. Senior aerospace students who participate in the lab are faced with ambiguous situations, heavy workloads, and pressure to complete tasks under time constraints throughout the semester during three simulations; thus, individual and team adaptive capacity are important for performance. This research examined the relationship between students' self-rated individual and team adaptive capacity and assessed the progression of reported levels of these constructs across the semester. At the individual level, individual and team adaptability were positively correlated yet still representative of distinct constructs. At the team-level, by the end of the semester, team members' individual adaptability scores were positively related to the teams' adaptability scores. As for the differences in adaptability across the semester, at the individual level, both measures increased; only team adaptability increased across the semester at the team level. Future analyses will explore the relationship between team adaptive capacity and performance outcomes.



## Production and Post-Production Audio Practices for Concert Specials (DVDs, TV, Streaming)

Ekaterina Kuznetsova, Graduate student, Recording Industry; Matt Foglia (Faculty sponsor)  
Recording Industry

I am researching the recording and production techniques that improve the quality and availability of audio for live concert specials. With DVD, Blu-ray, and HD formats, the technical quality of audio has significantly increased. Improved processing algorithms make it possible to achieve lossless compression and minimize the file size for storage while multichannel surround sound helps bring about additional realism. As a result of these improvements, the production and post-production process has become more and more complicated.

My creative component includes recording four concerts with the EMC mobile production truck, post production, editing, and audio mixing: *Dark Side of the Moon* is a Pink Floyd progressive rock tribute from the MTSU Tucker Theatre; *Riders in the Sky* is an example of cowboy western music; a Nashville Symphony concert is an example of orchestral music including theatre scenes with actors; the outdoor Bonnaroo festival is an example of pop/country music. For the Nashville Symphony shoot, I also acted as a director, performed video multi-cam editing and mixed audio during the post production process. Throughout these projects, I learned how to address length of program limitations and performance errors, program continuity, and technical specification requirements. Additionally, in collaboration with lead audio engineers of the industry, I developed a diagram of the Signal Flow for Surround 5.1 production from the microphone through the broadcast truck and a satellite to the consumer's TV.

At the Scholars Week presentation, I will bring a laptop with monitor headphones in order to demonstrate the audio/video multi-track projects. In particular, I will show how drum sample replacement, vocal tuning, and audience sweetening work for post-production of concert specials.

### Automated Method for Watershed-Scale Description of Riparian Vegetation Using LiDAR

Clark Milam, Graduate student, Geosciences; Henrique Momm, Faculty, Geosciences; Henrique Momm (Faculty sponsor) Geosciences

In agricultural watersheds, the presence of riparian vegetation can reduce topsoil loss and chemical/nutrient transport from agricultural fields into downstream waterbodies. The efficiency of riparian buffers depends on multiple physical characteristics such location (within the field and within the watershed), width, vegetation type, topography, and possible presence of concentrated flow paths, referred to as “short-circuit”. In this study, an automated GIS methodology was developed to characterize riparian vegetation with focus on describing their potential of functioning as vegetative buffer strips for sediment trapping. Multiple raster grid layers were generated from LiDAR datasets. These layers were classified using automated procedure to identify riparian forested zones and subsequently develop a database of parameters describing all concentrated flow path entering the riparian zone. Parameters in the database include upstream drainage area, flow path length and slope, land use, soil type, and topographic indices. The database in concert with riparian buffer layer were used to identify potential short circuits. The developed technology was illustrated through its application to the Goodwin Creek Watershed located in Mississippi.

## Electric Vehicle Charging Stations (EVCS) Usage Analysis in Murfreesboro, Tennessee

Lorena Jaeger, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)  
Engineering Technology

In recent years, there has been an increased concern about the environmental crisis that affects our planet. Air pollution is one of the major contributors to such crisis, causing diseases or death to humans, animals and plants. Such environmental problem originated the necessity to search for solutions that improve the quality of the air we breathe. The further development and increased production of electric cars were a result of the quest to find a solution, which positive outcome have prompted private and public entities to promote its utilization among the population. One way to increase the usage of the electric cars is to have an infrastructure in place that provides drivers with an easy access to charging stations, or Electric Vehicle Supply Equipment (EVSE). Such EVSEs have been installed in recent years around the United States, including several in Murfreesboro in Middle Tennessee.

EVSE stations around the city of Murfreesboro in Tennessee are seeing as empty parking spaces in which no electric cars are parked or being charged. It is possible that such stations might be under-utilized, prompting the question of whether the monetary investment of the project has been worthy so far. In addition to that, there is a perception issue that talks about the interest of the population in purchasing and driving electric cars. Has the penetration increased since the installation of the EVSE stations until today? Has it decreased or stalled?

An analysis of the usage of the local charging stations would be helpful to city government and the electric car industry to understand how the behavior of locals and visitors affects such investment, as well as to have a clearer idea of what the future of such stations would be.

## Middle Tennessee State University's Vietnam Veterans Memorial Project

Bethany Hall, Graduate student, Geosciences; Derek Frisby, Faculty, History; Derek Frisby (Faculty sponsor) History

The project began as an effort to verify military map grid casualty location coordinates with Global Positioning Systems (GPS) and Geographical Information Systems (GIS) technologies while ground truthing the primary source records by physically inspecting the reported locations of fifteen MTSU students killed during the Vietnam War. The GPS and GIS project worked in conjunction with MTSU's Geoscience, Global Studies and Public History Departments, Rutherford County GIS volunteers and Vietnam Battlefield Tours.

Working as a team, the group decided to focus their search areas to the Quang Tri, Quang Tin and Thua Thien provinces of central Vietnam in attempt to locate the battlefield casualty locations of CAPT. James Luscinski, 2LTs. John Fuqua and Kenneth Kirkes, CPLs. James Howard and Prentice Bennett, SP4. Jerry Lovell.

The project has produced a poster, an online story map with media and interest in returning to Vietnam in 2018 attempting to locate the casualty locations of the eight remaining men who gave their lives in Vietnam from MTSU.

## Web-Ready Mobile Broadcast Audio Engineering Tutorials

Ryan Adams, Graduate student, Recording Industry; Cosette Collier (Faculty sponsor) Recording Industry

A student of audio engineering can quickly and easily search the web for concise, effective tutorial videos on many topics from the setup and operation of audio devices to fundamentals of audio signals or even advanced theory on engineering/mixing technique and workflows. Search the web for broadcast audio tutorials or reference material on how to engineer audio for mobile broadcast productions, however, and one will discover very little. A YouTube search will provide some short interviews with engineers, promotional videos for mobile production companies and schools, and nothing further. In 2014, as a student preparing for engineering audio on a TV truck, I wanted more content. The educational opportunities for the field of Audio Engineering Technology (AET) continue to grow, but are frustratingly focused primarily on popular music recording in a studio setting. Students are exposed to a strong background in AET fundamentals, but few classes exist to prepare a student engineer for the transition from a music studio environment to a mobile broadcasting environment. My final project consists of the production of at least ten short educational video tutorials of audio engineering for broadcast, as well as a YouTube channel for dissemination and research to back up my experience in broadcast audio. The intended audience for these web videos will be exactly those AET students who already have a background in audio fundamentals and need specialized instruction to prepare for mobile broadcast opportunities. Additionally, I will have created resources to assist educators creating curriculum in this underserved niche of AET education. I am currently researching the subject and preparing an article detailing the research undertaken as well as its learning outcomes.

### Sound for a Musical Web Series: Incognita's Infamous Adventures

Sarah Bailey, Graduate student, Recording Industry; Matt Foglia (Faculty sponsor) Recording Industry

Pursuant to the completion of an MFA in Recording Arts and Technologies, I am creating a musical web series, "Incognita's Infamous Adventures." While this project has involved many aspects that are not associated with sound, the bulk of my research has been about the process of creating and finessing the sound aspects of a musical web series. As this project involves music production, studio engineering, music programming and sound for picture, it is a true culmination of my studies at MTSU.

This project will appeal to anyone who is a fan of the musical theatre genre, the superhero genre, Disney movies, or anime. Spanning influences from "Frozen" to "Dr. Horrible's Sing-Along Blog," we plan to target a vast demographic.

My scholarly research is centered around two areas – music production and sound for picture. I studied composition and production techniques, song chart performance, microphone frequency response, engineering techniques, location sound and post-production sound, and advanced MIDI programming. In short, my research has enabled me to be responsible for all aspects of sound for a musical web series.

I have completed pre-production for the pilot and will film in March. I have had studio musicians and the cast in to record live instruments and vocals. The pilot was approved to satisfy the requirements for graduation in May. That being said, the project has gained so much momentum that the rest of the series will be filmed in July. The finished product will be submitted to film festivals and released on online platforms, and the 15-song original soundtrack will be commercially released.

## Feasibility Study of the Incorporation of Wind Turbines at Blast Fences

Srinivasa Srikar Singaraju, Graduate student, Aerospace; Nate Callender (Faculty sponsor)  
Aerospace

Airports require vast amounts of energy to power their operations. They operate around the clock: 24 hours a day, 365 days per year. Given this, they have a huge ability to save energy. Airport operators have a global goal of reducing their Carbon dioxide emissions by 50% by 2050. To minimize the electrical energy usage at airports, the airports could take some initiatives such as the installation of wind turbines. Installation of wind turbines at airports would be beneficial as there is a lot of wind blowing in and around airports because of the landings and take-offs of aircraft. During engine run-ups, aircraft exhaust huge amount of high velocity wind. Erecting small wind turbines at key locations could yield great results as there are many aircraft which fly from all the airports every day.

Unlike many other thesis methodologies, this research does not involve any participants, surveys, interviews or tests for the data collection process. All the data required for the analysis will be composed by performing extensive desk research. The main procedure of this research is taking the jet blast velocity profiles of different aircraft and the numbers of landings will be used to know how much wind is generated by the aircraft. The jet blast from the aircraft is used to rotate the turbines that in turn generate power that can be used for other airport electricity purposes. The power generated by the turbines will be calculated by computing average wind flow rate at the blast fence.

Findings from this research will be beneficial for airport operators as well as to governmental organizations associated with aviation in finding a way to minimize the cost cuttings by saving electrical energy given out from the wind turbines and working collectively for the betterment of the environment.

## Antisense Long Non-Coding RNAs in Rainbow Trout: Discovery and Potential Role in Muscle Growth and Quality Traits

Ali Ali, Graduate student, Biology; Rafet Al-Tobasei, Graduate student, Computer Science; Timothy Leeds, Non-MTSU university faculty collaborator, ; Brett Kenney, Non-MTSU university faculty collaborator, ; Mohamed Salem, Staff, Biology; Mohamed Salem (Faculty sponsor) Biology

Endogenous mRNA-antisense transcripts are involved in regulation of a wide range of biological processes, including muscle development and quality traits of terrestrial food animal species. Standard RNA-Seq can be used to identify sense-antisense transcripts. However, strand-specific RNA-Seq is required to resolve ambiguity in overlapping genes. To precisely identify antisense lncRNAs (AS-lncRNAs) in rainbow trout, two stranded RNA-Seq data sets from muscle and gill tissues were used. Applying a computational pipeline that we previously described (Al-Tobasei et al 2016), a total of 30,907 lncRNAs was identified; of these lncRNAs, 862 (2.79%) were transcribed from the opposite strands of protein-coding genes in the rainbow trout genome. RNA-Seq was used to identify differential- and co-expression of AS-lncRNA-protein coding genes in association with 5 important growth and muscle quality traits: whole body weight (WBW), muscle yield, muscle crude fat content, shear force, and whiteness. Phenotypic data were collected from ~500 fish representing 98 families (5 fish/family) of a USDA growth-selected line. Muscle AS-lncRNAs and protein-coding genes were sequenced from 26 families showing divergent phenotypes (4 high- versus 4 low-ranked families/trait). AS-lncRNA and their sense genes coding for lipoprotein lipase and adipocyte plasma membrane-associated protein were upregulated in families showing higher WBW, fat content, muscle yield, and whiteness. Conversely, AS-lncRNA and its sense gene coding for response gene to complement 32 protein were downregulated in families showing increased WBW. This study highlights the role of AS-lncRNAs in post-transcriptional gene regulation governing muscle growth and quality traits in salmonids.



## Leveraging Cloud-Based Resources for Remote Sensing Data Analysis: A Pilot Study of Cloud Masking and Vegetation Indices Using Google Earth Engine

Laura Trujillo, Graduate student, Professional Science; Henrique Momm (Faculty sponsor)  
Professional Science

Government and private agencies have collected large amounts of remotely sensed imagery dating back to the 70's. These datasets support multi-temporal studies designed to develop understanding of a wide range of global challenges. Performing long-term studies often require downloading large amounts of data from multiple sources and pre-processing them locally. Depending on the time period being investigated and size of study area, this represents a computational challenge due to the sheer amount of raw data being downloaded and subsequent computational overhead needed for converting data into information. Alternatively, cloud-based tools such as Google Earth Engine, offer ready access to a large government and private imagery repository and contains built-in geospatial/remote sensing algorithms for cloud-based data analysis. Based on this premise, we developed an algorithm for processing the entire Landsat 8 collection for a specific area between 2000 and 2015. We generated atmospherically corrected, surface reflectance, Normalized Difference Vegetation Index (NDVI) images and corresponding cloud masks. Temporal composites of NDVI images are used to describe vegetation health changes over time and temporal composites of cloud masks are used to assess the quality of NDVI images due to cloud contamination. This study describes the algorithms and methods used within Google Earth Engine to generate and download these datasets.

The Mystery of the Vanishing Sleuth: The Representation of Nancy Drew in Cover Design from 1930 to 2016

Leah Bailey, Graduate student, Media and Communication; Jane Marcellus (Faculty sponsor)  
Journalism

This paper uses a semiotic analysis to examine the representation of the character Nancy Drew on book covers in 12 series featuring Nancy Drew between 1930 and present day. By studying the covers of books in the Nancy Drew series up to present day, the goal of this thesis is to discover how she is represented in order to better understand the meaning transmitted through the cover design as well as how a longstanding female character was represented in literary media marketed to youth since 1930. Focusing on the construction of Nancy Drew as well as themes present on the book covers, the paper argues that the representation of Nancy Drew as a strong and independent woman transformed over time to a much weaker and dependent representation.

Using Under-Water Close-Range Photogrammetry and GIS Analysis in Jervis Bay, Australia, to Monitor the Seascape and Marine Eco-system for Consideration as a Marine Protected Area

Sean Hadley, Graduate student, Geosciences; Henrique Momm (Faculty sponsor) Geosciences

This study will present my research proposal for a project to investigate the feasibility of under-water close-range photogrammetry and GIS analysis to monitor marine seascape. A detailed literature review will characterize work in this field and will be used to define standard and structure-from-motion photogrammetric techniques guidelines for long-term monitoring of seabed features. The challenges involve the definition of fixed set of control points between surveys, illumination differences, and other limitations posed by water currents. The proposed study site is the Jervis Bay, in Australia, which is home to Booderee National Park and Botanic Gardens, a culturally significant area to the Aboriginal peoples of the area. Developing remotely sensed conservation practices, support the development of non-destructive methods that will generate vital information for preserving and developing understanding of potential changes marine wildlife. With this information, the local government will be approached with a proposal for candidacy as a marine protected area.

## Impact of Technology on Web Accessibility

Viswanath Pamarthi, Graduate student, Computer Science; Joshua Phillips (Faculty sponsor)  
Computer Science

Web accessibility is the concept of making the content of the pages usable for all, including disabled users (*e.g.* learning disabilities, blindness or visual impairment, mobility or orthopedic impairment). In this study, we utilize 75 top websites (<https://moz.com/top500>) to assess the impact that development technology has on web accessibility. We focus, in particular, on three categories of technologies: content management systems, JavaScript Frameworks, and programming languages. We use the tool “CynthiaSays” to assess the accessibility of web pages against the Web Content Accessibility Guidelines (WCAG) 2.0 and the tool “Wappalyzer” to find the technology used on the web pages. We anticipate that accessibility varies based on the technology of choice for website development when analyzing the data using appropriate statistical methods. The results of this study will be useful for, but not limited to: web developers, educational institutions to develop the e-learn portals etc.

### Research Project on Extended Warranty Remarketing Analysis

Mengyu Chen, Graduate student, Mathematics; Jessica Small, Graduate student, Professional Science; Don Hong (Faculty sponsor) Mathematics

This presentation is to report a recent research project on extended warranty rate-making analysis conducted by a research team in the Actuarial Science program at Middle Tennessee State University. The main goal of this project was to predict the following year's liability insurance coverage based on past records and to make insurance policies for the next year. The original data set was very informative, including over 500,000 records, such as product types, warranty types, repairing dates and expenses. In addition to data preprocessing, we focused on different types of cars and then chose Negative Binomial model to fit the claim frequencies, while Lognormal model was chosen for severities. Statistical methods such as Moment Matching are applied to parameter estimations. The predictive model provided the insurance company on pricing for the extended warranty policies. More advanced models are under investigation for better fitting the data and more accurate estimates for prediction.

Genomic Analysis and Comparison of Novel Bacteria *Candidatus Berkiella aquae* and *Candidatus Berkiella cookevillensis*

Destaalem Kidane, Graduate student, Molecular Biosciences; Mary Farone (Faculty sponsor)  
Biology

The two novel bacteria of the phylum Proteobacteria were isolated from amoeba recovered in biofilms in Cookeville, TN. *Candidatus Berkiella aquae* (strain HT99) was isolated from an outdoor hot tub and *Candidatus Berkiella cookevillensis* (strain CC99) was isolated from a hospital cooling tower. Both bacteria are non-spore forming, motile, gram-negative bacterium appearing as cocci to coccobacillus with diameters ranging from 0.30 to 0.60  $\mu\text{m}$ . Both HT99 and CC99 infect amoeba host, exhibiting intranuclear growth and replication. Notably, CC99 also infects and replicates within the nucleus of mammalian cells, which is a rare occurrence in nature. The mechanism of infection and intracellular replication for each bacterium is currently unknown. This study describes the genomic analysis and comparison of these two novel bacteria. The genome of HT99 consists of one circular chromosome of 3,625,323 base pairs (bp) with a G + C content of 39.5 %, while the genome of CC99 consist of a circular chromosome of 2,990,285 bp with a G + C content of 37.9 %. Several annotation and prediction software programs were used to analyze and compare the whole genome sequence of both bacterium in order to predict genes involved in intracellular replication.

## An Analysis of Research Methodologies in Biology Education Research

Joshua Reid, Graduate student, Mathematics and Science Education; Grant Gardner, Faculty, Biology; Penny Carroll, Graduate student, Mathematics and Science Education; Velta Napoleon-Fanis, Graduate student, Mathematics and Science Education; Emily Smith, Graduate student, Biology; Grant Gardner (Faculty sponsor) Biology

Biology Education Research (BER) has become a unique emergent area of disciplinary-based education scholarship over the last two decades. A few previous studies have sought to understand the pedagogical implications of BER literature for teaching and learning in biology (Dirks, 2011). Others have reviewed the historical development of BER as a research field (DeHaan, 2011; Dirks, 2011) or have used descriptive content analysis to review trends in the emerging field of BER (Gul & Sozibilir, 2016). However, no reviews have looked at the methodological trends of BER as a whole to understand how this field has evolved or indicated the major gaps in the current literature to carefully inform the future of the field.

The purpose of this study was to describe the trends in BER methodology over the last one and a half decades as represented by articles in *CBE – Life Sciences Education*, the premier journal in BER. A comprehensive review of trends in BER methods from all *CBE* articles resulted in a sample size of  $n = 377$ . Relevant data was collected using an online tool and then analyzed through synthesis, comparison, and gap analysis to identify trends. Specifically, the researchers have characterized the various research designs, sample descriptions, and methodologies used in BER over the last fifteen years.

Analysis has revealed trends in research design and reporting of sample demographics. The majority of the studies were conducted in post-secondary institutions in the United States. We found that most instruments used in the published studies were researcher designed. However, aligning with this, we also found a longitudinal trend of more studies reporting validity and reliability data for their measurement instruments. The researchers provide suggestions and implications for the future directions of BER.

## To What Extent Do Individuals Living in a County with High Illicit Drug Use Recognize Addiction as an Illness?

Tara Prairie, Graduate student, Health and Human Performance; Miranda Givens, Undergraduate student, Health and Human Performance; Angela Bowman, Graduate student, Health and Human Performance; Norman Weatherby, Faculty, Health and Human Performance; Norman Weatherby (Faculty sponsor) Health and Human Performance

The American Society of Addiction Medicine (ASAM) defines addiction as a primary, chronic disease that is progressive and without treatment or engagement in recovery, can lead to disability or death. Despite acceptance of this definition in the medical field, community dwelling individuals continue to harbor bias against individuals struggling with addiction which can lead to stigma and discrimination. The purpose of this study is to examine the extent to which individuals living within a county with reported high levels of illicit drug use acknowledge addiction as a disease. The Perceived Stigma of Substance Abuse Scale is a 4-point Likert scale that measures participant views on addiction. It was adapted into an online survey and distributed in Grundy County, TN. The responses will be analyzed on an item by item basis using SPSS statistical software and descriptive statistics will be reported. Preliminary statistics show that the drug mortality rate of Grundy County, TN was 35/100,000 in comparison to the overall state which was 18/100,000. Additionally, 81% of admissions to a drug treatment facility involved an addiction to opioid prescriptions. We predict that individuals from Grundy County will exhibit bias against individuals struggling with addiction and not recognize addiction as a disease.



## Exploring Prospective Mathematics Teachers' Developing Feedback Practices Through Letter Writing

Kristin Hartland, Graduate student, Mathematics and Science Education; Matthew Duncan, Graduate student, Mathematics and Science Education; Alyson Lischka (Faculty sponsor) Mathematics

Little is known concerning how prospective teachers (PTs) develop feedback practices to promote learning. Feedback is one of the most influential actions a teacher can take to improve student learning (Hattie & Timperley, 2007). This study presents three cases of PTs' developing feedback practices through a letter writing exchange with high school learners over a semester-long mathematics methods course.

We define feedback as communication to a learner for the purpose of furthering their understanding and which is expected to be taken up by the learner. We adopted Hattie and Timperley's (2007) feedback framework as a lens for analyzing the ways in which PTs provide feedback: "Where am I going? . . . How am I going? . . . and Where to next?" (p. 86). The authors categorize feedback within the questions as focused on the task, process, self, or self-regulation.

Data for this study were the letters exchanged between PTs and learners along with reflective papers and interviews. Three PTs corresponded with 21 learners in an Algebra II course. PTs wrote five letters involving discussion of a problem that could be modeled with a trigonometric function. Feedback in the letters was coded according to the type of feedback provided and learner solutions were coded according to correctness, depth of explanation, and progress toward a solution. Corroborating and disconfirming evidence was coded throughout the additional data.

Preliminary analysis revealed that PTs provided both feedback on the task and the process but that each PT exhibited different patterns in their feedback as the exchange progressed. Insight into PTs feedback practices has potential to provide teacher educators information from which to build activities that develop feedback practices and attend to PTs existing ideas about feedback.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77, 81-112.

## Impact of Artificial Intelligence in Today's World

Adekunle Afolabi, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor)  
Engineering Technology

Artificial intelligence is an intelligence which is exhibited by machines, it makes object learn about their environment and make decisions based on what they learned. Artificial intelligence is currently a big area of study in computing, it has been widely used in various fields of endeavors. In this study, I will be looking into various ways in which artificial intelligence has impacted how we live, both in positive and negative ways, this poster would also discuss some current and future trends in the area of artificial intelligence, some of the prominent areas are in healthcare, entertainment, business, social media and so on.

## Instruction and Intervention Practices at National Blue Ribbon Title I Schools

Kari Miller, Graduate student, Educational Leadership; Nancy Caukin (Faculty sponsor)  
Educational Leadership

While many schools nationwide are struggling to meet the needs of diverse subpopulations of students, others are successfully closing achievement gaps and educating all students at exceptional levels of performance. This qualitative research study investigated the question “What were common instruction and intervention practices at 2014 National Blue Ribbon Title I schools as identified on their applications for the award?” To determine the answers to this question, all Title I school applications for 2014 National Blue Ribbon Schools, specifically for those classified as Exemplary Gap Closing, were examined and coded, with concepts and categories resulting from the data analysis process. Four hundred ninety-four data points were found within the thirty-three applications, with two primary themes emerging from the grounded theory research. Instructional strategies (including differentiation and use of targeted instructional strategies) and factors related to a Growth Mindset (including building capacity of students and staff, along with instilling a positive school culture) were found to be the critical components to closing the achievement gaps in Title I, National Blue Ribbon Schools. These results may provide guidance to other schools on a mission to close critical achievement gaps.

## Validity of MAPS Score as a Functional Measure in Adults with Incomplete Spinal Cord Injury

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Current functional measures for adults with spinal cord injury are limited in their ability to assess person-environment interaction of function. Movement and Activity in Physical Space (MAPS) Score, an objective functional measure that encompasses both physical activity and environment interaction, has been successfully applied to measure various patient populations; however, it remains unknown if MAPS score is valid in adults with incomplete spinal cord injury.

To validate a functional measure, MAPS score, in adults with incomplete spinal cord injury using evidence of convergent and known-group difference validity.

Nine adults with incomplete spinal cord injury were participated in this study. Participants were required to wear an accelerometer as well as a GPS unit to carry while out of the house for seven consecutive days, except while sleeping or grooming. The accelerometer was used to measure free-living physical activity. The Tracking Key GPS receiver was used to record participants' location (latitude/longitude). MAPS scores were calculated by combining data from the accelerometer and GPS for each day to assess patient function. The functional ambulation measures including walking speed, walking distance (6 minutes), and walking index were also collected. The relationship between MAPS and three functional ambulation measures was evaluated using a Pearson product moment correlation for convergent validity evidence. Known-group difference validity evidence of MAPS score was assessed using independent t test between high and low level of impairment groups. MAPS score was moderately correlated with walking index ( $r=.74$ ), walking speed ( $r=.64$ ) and walking distance for 6 mins ( $r=.56$ ), and respectively. Also, there was a significant difference in MAPS score between high ( $5.27\pm 7.12$ ) and low ( $35.65\pm 23.55$ ) level of impairment groups,  $t(6.47)=-2.97$ ,  $p=.023$ .

This study provides a foundation of convergent and known-group difference validity evidence for the use of MAPS score as a functional outcome measure in adults with incomplete spinal cord injury.

## Towards the Molecular Identification of Afr2, A Gene Implicated in Liver Cancer

Zach Grimes, Graduate student, Biology; Rebecca Seipelt-Thiemann (Faculty sponsor) Biology

The liver is the largest internal organ and performs many functions. In humans, liver cancer is the 5th leading cause of cancer death in men, and the 9th in women.  $\alpha$ -fetoprotein (AFP) is a fetal protein that is active during liver development and hepatocellular differentiation. After the development stage, AFP is transcriptionally silenced due to the action of  $\alpha$ -fetoprotein regulator 1 (Afr1). However, during liver regeneration and tumorigenesis, AFP expression is reactivated by the action of  $\alpha$ -fetoprotein regulator 2 (Afr2). It is this observation that has led to the use of AFP levels as a diagnostic marker for liver cancers. Two strains of mice differ in their ability to develop liver tumors. C3H/HeJ mice develop liver tumors and express high AFP levels in the regenerating liver while C57/BL6 do neither. Heterozygote mice express an intermediate level of AFP and show reduced tumorigenesis. Recombination mapping showed that Afr2 is located on chromosome 2. The purpose of this study was to use a corrected genetic map and existing data to identify Afr2 candidate genes. First, genetic differences between the strains for the selection region of chromosome 2 were identified via Mouse Genome Informatics and the Sanger-Wellcome Trust Institute. Gene ontology and domain identification databases were used to gain information about genes that showed variation between strains. Several potential regulatory genes were identified and compared to a list of genes obtained from microarray analysis. Through combinatorial analysis of these lists, 4 genes were identified as candidates, and 1 was identified as the most likely candidate due to Gene Ontology. Finally, a one hybrid analysis of the candidate gene will be undertaken to confirm which candidate gene is actually Afr2. Identification of Afr2 may lead to better therapeutics for treatment of liver cancer due to its pivotal role in directing liver-specific gene expression.

## Subspace Clustering of Molecular Simulation Data

Ivan Syzonenko, Graduate student, Computational Science; Joshua Phillips, Faculty, Computer Science; Joshua Phillips (Faculty sponsor) Computer Science

Clustering methods have been used to analyze data from molecular simulations for decades, but with mixed results. Researchers have typically made several well-intentioned, yet incorrect assumptions when choosing clustering algorithms which have resulted in only fair performance and have limited the potential impact of clustering in molecular simulation analysis. First, popularity has been preferred over principle, where well-known or classic algorithms have been used without realizing that many assumptions made by these algorithms concerning the nature of the data do not match the simulation conditions. Second, most studies have focused on using only a single algorithm mainly as an exploratory tool. Subspace clustering (SC) approaches make the assumption that not all data points will reside in the same dimensional subspace, which is in direct contrast to traditional techniques that typically ignore this observation. The widely accepted “landscape theory” of protein (un)folding indicates that not all motions and molecular states will belong to the same dimensional subspace, suggesting that subspace methods will provide substantially better insight than traditional approaches. We apply both subspace and traditional spectral clustering approaches to target protein simulations to determine if features predicted by landscape theory are more accessible to subspace methods than traditional approaches. We find that subspace methods outperform traditional spectral methods in terms of their ability to identify common dynamical features and separate unique dynamical features from independent simulations. We utilize dimensionality reduction techniques to visualize and better understand these features which will form the foundation of a polymer-theory validation framework for clustering methods applied to molecular dynamics simulations.

## Identification of cSNPs Associated with Resistance to *Flavobacterium psychrophilum* in Rainbow Trout

Pratima Chapagain, Graduate student, Biology; Rafet Tobasei, Graduate student, Computational Science; Mohamed Salem (Faculty sponsor) Biology

Single nucleotide polymorphisms (SNP) can be used as genetic markers in genomic selection of aquaculture species. Two genetic lines ARS-Fp-R(resistant) and ARS-FP-S (susceptible) were created by selective breeding and they show significant variation in the survival rate on exposure to the *Flavobacterium psychrophilum*, the etiological agent of bacterial cold water disease. RNA-seq, whole-body transcriptome analysis, of pooled RNA samples was used to identify coding/functional SNP (cSNPs) from the resistant and susceptible genetic lines.

Fish from 16 different groups belonging to resistant and susceptible genetic lines were collected on day 1 and day 5 post-challenge with Fp versus PBS injection. Using GATK and SAMtools bioinformatics pipelines, 246,506 cSNPs were identified. Pairwise comparison between genetic lines and infection status was used to identify cSNPs with allelic imbalance (having scores  $>5.0$  as amplification and

## Development of a GC-MS Method for Quantifying Non-polar and Polar Biogenic Terpenes from Plants

Masoumeh Dalilian, Graduate student, Chemistry; Ngee Sing Chong (Faculty sponsor)  
Chemistry

Vegetation releases trace levels of biogenic volatile organic compounds (BVOCs) to deter insects and to respond to the conditions of environmental stress. The most common BVOCs include monoterpenes ( $C_{10}H_{16}$ ) or their terpenoid derivatives (*i.e.*  $C_{10}H_{16}O$ ) derived from isoprene ( $C_5H_8$ ). Studies have shown that isoprene may react with nitrogen oxides ( $NO_x$ ) to produce tropospheric ozone in the presence of solar radiation. Terpenes also lead to the formation of secondary organic aerosols that contribute to particulate pollution. The large acreage of pine, cedar, oak, and other vegetation in the southeastern U.S. contributes a significant amount of terpenes that play a key role in air quality in this region and are of great interest to atmospheric scientists. This presentation is focused on the development of a method that can reliably measure the levels of both the relatively non-polar monoterpenes and the more polar terpenoid compounds like terpineol, borneol, fencone, and linalool. The samples in a forest setting and a controlled study of cut tree branches will be collected using sorbent tubes and canisters before being analyzed by gas chromatography-mass spectrometry (GC-MS). A modified sorbent tube with derivatizing reagent is used to convert polar terpenes into more volatile substances in order to improve their analytical sensitivity. The results from both the canister and sorbent sampling methods will be compared and the method of in situ derivatization on sorbent tube will be evaluated for its suitability in characterizing the profile of terpenes in regions where tropospheric ozone and secondary organic aerosol directly impact air quality.



## Cross-Validation of the Developed Obesity Cut-Off Points for Korean adults

Junbae Mun, Graduate student, Health and Human Performance; James L. Farnsworth, Graduate student, Health and Human Performance; Heontae Kim, Graduate student, Health and Human Performance; Seungho Ryu, Graduate student, Health and Human Performance; Minsoo Kang, Faculty, Health and Human Performance; Minsoo Kang (Faculty sponsor) Health and Human Performance

**BACKGROUND:** Several different cut-off points (CP) have been developed for obesity; however, there are no cross-validation studies for the developed obesity CP. Therefore, the aim of this study is to examine the diagnostic accuracy of obesity CP.

**METHOD:** Data (9,425 adults [ $\geq 18$  years], men = 4,031) from the 2008 and 2011 Korea National Health and Nutrition Examination Survey was analyzed to examine the accuracy of obesity CP developed using three obesity indices: body mass index (BMI; 23, 24, 25, & 26kg/m<sup>2</sup>), waist circumference (WC; 84, 85, & 90cm for male; 78, 80, & 85cm for female), and body fat percentage (BF%; 20, 21, & 26 for male; 36 & 37 for female). CP of BMI, WC, and BF% were evaluated using Youden Index (YI; sensitivity [SE] + specificity [SP] - 1). To evaluate the CP with highest YI, adjusted odds ratios (OR) were calculated.

**RESULTS:** Overall, SE and SP of the CP were low across three obesity indices (SE=29.26-75.86%, SP=46.51-85.98%). CP with highest YI were BMI of 23 (SE=69.25%, SP=53.21%), WC of 84 (SE=62.68%, SP=66.67%), and BF% of 20 (SE=75.86%, SP=46.51%) and BMI of 23 (SE=66.74%, SP=64.86%), WC of 78 (SE=69.52%, SP=67.89%), and BF% of 35 (SE=50.73%, SP=69.64%) for men and women, respectively. Obese adults were more likely to have cardiovascular disease risk factors compared to none-obese adults (OR=2.61-2.96, 95% CI=2.19-3.63 for men; OR=2.05-3.00, 95% CI=1.69-3.60 for women, respectively). CP of WC had the highest YI and OR while the CP of BF% had the lowest for both male and female.

**CONCLUSIONS:** WC of 84cm for male and 78cm for female were identified as the best obesity CP to predict CDRF for Korean adults. The overall diagnostic accuracy (i.e., SE and SP) of the obesity CP, however, was performed poorly. Therefore, caution is necessary when using the developed obesity CP.

## Generating Historical Crop Data Layers Using Spectral Feature Fitting Algorithm

Wesley Porter, Graduate student, Geosciences; Henrique Momm, Faculty, Geosciences; Jeremy Aber, Faculty, Geosciences; Racha El Kadiri, Faculty, Geosciences; Henrique Momm (Faculty sponsor) Geosciences

Specific crop identification using remotely sensed imagery continues to grow. A large number of applications rely on this data including precision agriculture, non-point source pollution estimation, water management, and commodity pricing. The Crop Data Layer (CDL) is an annual crop-specific land cover GIS dataset created nationally since 2008, using satellite imagery and extensive ground truth. A CDL has a number of beneficial uses such as providing crop acreage estimates while documenting agricultural land use. The latter is of particular interest when studying historical agricultural management practices. Because remotely sensed imagery is available from as far back as the 70s, a successful algorithm could extend CDL temporal coverage by more than two decades allowing for long-term studies of agricultural practices. This pilot study was conducted to develop and assess a remote sensing method to generate pseudo-CDL datasets based solely on remote sensing. The study site is located 3 miles North of Verona, ND, and covers 30 contiguous fields. The farming management included crop rotations of corn, soybeans, and wheat during the growing seasons in 2014 and 2015. Atmospherically corrected surface reflectance imageries from Landsat 8 were used to create temporal composites of Normalized Difference Vegetation Index (NDVI) depicting vegetation health. Due to localized cloud contamination, temporal resolution of the NDVI composite datasets was enhanced using quadratic interpolation to fill in data gaps and ensure that data dimensionality was equal in 2015 and 2014. Phenology curves for each crop were considered as reference “spectra” and each temporal-NDVI curve was classified using the Spectral Feature Fitting (SFF) algorithm to create thematic images, or pseudo-CDL for 2015 and 2014. Initial results indicate feasible agreement between estimated (pseudo-CDL) and CDL datasets (overall accuracy = 54.38). Future work will include adding more images from different sensors and quantifying cloud contamination.

### Benchmarking Instrument Panel Line at Calsonic Kansei Company

Fatemeh Dalilian, Graduate student, Engineering Technology; Vahid Khiabani (Faculty sponsor)  
Engineering Technology

The first step for making improvements is to understand our current situation. Therefore, it is critical for companies to assess their production performance to see how well the production lines are doing versus how well they could be doing by using the same material, equipment, and manpower. As Little's law ( $TH = CT/WIP$ ) implies, it is possible to achieve the same throughput with long cycle time and large WIP or short cycle time and small WIP. Obviously, short cycle time and small WIP is preferred, but the question is how small the cycle time and WIP should be to call the process lean. We can assess a process performance to see how lean a company is by using statistical techniques and internal benchmarking. As a case study, we picked a line in Calsonic Kansei company to see if it is operating lean. First, we showed that the process is in control and used internal benchmarking developed by the Factory Physics book and Little's Law to assess the production line performance. The result showed that the current throughput is 119% of marginal case throughput and current work in process is 28% less than practical worst case. Both results indicate that the system is working lean as the throughput is greater than marginal case throughput and WIP is less than marginal case WIP. This information can help the company make decisions about buying new equipment, using parallel machines, smoothing the processes, and analyzing the performance, and on the whole discovering room for improvement throughout the process.

## Computational Modeling of pH Sensitivity in the Critical HIV GP120-CD4 Interaction

Jonathan Howton, Graduate student, Computer Science; Joshua Phillips, Faculty, Computer Science; Joshua Phillips (Faculty sponsor) Computer Science

Although acquired immune deficiency syndrome (AIDS) was discovered more than thirty years ago, an effective vaccine against the human immunodeficiency virus (HIV) that causes the disease has not yet been produced. This is potentially because most HIV vaccine research has been performed under slightly basic, systemic blood/plasma conditions, while transmission events often occur under highly acidic, mucosal conditions. Furthermore, the gp120 envelope protein, which initiates transmission via binding to host cell receptor CD4, has been shown to more effectively bind CD4 under acidic conditions presumably due to favorable, pH sensitive conformational changes. We have used computational modeling to compute the strength of the gp120-CD4 interaction for a variety of gp120 sequences over a physiologically relevant range of pH values, and found that the interaction is strongest at low, mucosal level pH. We also compared the pH sensitivity of this interaction between early infection transmission/ founder (TF) strains, and chronic control (CC) strains which circulate systemically post-transmission. We found that the gp120-CD4 interaction was more pH sensitive in TF strains, suggesting a different binding mechanism between TFs and CCs. To investigate these differences, we mapped sequence specific pH sensitivity onto the binding site of the solved gp120 structure 1RZK to test for residue specific pH sensitivity differences. Residues with significantly different sensitivities between TF and CC strains were used to identify structural differences that are likely to contribute to the difference in pH sensitivity of the gp120-CD4 interaction.

## A Logistic Regression Analysis of Opiate Prescription Pain Reliever Abuse by Access to Medicaid/Chip Insurance

Cynthia Bass-Thomas, Graduate student, Health and Human Performance; Heontae Kim, Graduate student, Health and Human Performance; Amber Dorsey, Graduate student, Health and Human Performance; Dr. Andrew Owusu, Faculty, Health and Human Performance; Andrew Owusu (Faculty sponsor) Health and Human Performance

**Background.** Drug abuse is a serious public health problem that affects almost every community and family in some way. The health insurance cost for opiate prescription pain reliever abuse includes excess medical and drug cost, substance abuse prevention, treatment, and research (Birnbaum et al, 2011). This study's focus is to examine if people who have Medicaid/Chip insurance are more likely to report ever using opiate prescription pain relievers non-medically than people without Medicaid/Chip insurance or private insurance.

**Methods.** Data from the 2014 National Survey on Drug Use and Health (NSDUH) were utilized. A total of 55,098 participants were sampled out of the 67,901 from the 2014 NSDUH. Prevalence estimates were calculated using Binary Logistic Regression to assess the relationship between Medicaid/Chip insurance and the use of opiate prescription pain relievers non-medically.

**Results.** Overall, 19.6% and 14.46% of participants reported having Medicaid/CHIP insurance and using opiate prescription pain relievers non-medically respectively. Medicaid/CHIP insured participants (14.46%) were significantly more likely to report ever using opiate prescription pain relievers non-medically compared to those who had private insurance; OR 1.55: CI 1.40-1.71).

**Conclusion.** The current study results provide evidence that the prevalence of reporting use of opiate prescription pain relievers non-medically may be higher among Medicaid/Chip insurance than among persons with private insurance. Further studies maybe needed to better understand this association. This information could be considered for intervention efforts among this population. Covariates controlled for in this analysis were income, imputation income revised, private insurance, any health insurance, mental or emotional difficulties, gender, race, and age.

**Objective.** To determine whether people who abuse opiate prescription pain relievers non-medically by access to Medicaid/Chip insurance.

## Latest Wireless Technologies for Home Security and Home Monitoring

Ayehualem Anteneh, Graduate student, Engineering Technology; Charles Perry (Faculty sponsor) Engineering Technology

Wireless communication is a way of exchanging data between different network elements by using radio waves. Everyday people try to protect their families or their property from harm. Wireless technology is one of the best system to monitor our house and our property. It can be installed easily and used as a security system. Using wireless technologies, we can monitor the inside and the outside of our house remotely. We can monitor our kids who are coming back from school while we are still outside. We can turn on and off the lights which is mostly important when we have elderly family or a sick family. In my poster, I will review latest wireless technologies and its applications for home monitoring and security system.

Human Breath Sound Detection Using a Microphone and Audio Signal Processing  
Ayehualem Anteneh, Graduate student, Engineering Technology; Lei Miao, Faculty, Engineering Technology; Lei Miao (Faculty sponsor) Engineering Technology

The detection and analysis of human breath sound have wide applications in medical research, mobile health care, search and rescue, and surveillance. In this project, we focus on detecting human breath sound. Existing human breath sound detection methods use laser, Wi-Fi, ultrasonic sensor, and radar. In our approach, we use a combination of microphone and audio signal processing techniques, which is less expensive and unobtrusive. The novelty of the research also lies in the fact that we do not use traditional frequency domain digital signal processing approaches; instead, we use a new and powerful time domain method known as Empirical Mode Decomposition (EMD). In the poster, we will show what EMD is and how it works via Matlab simulation. In particular, we will show how to use a sifting algorithm to identify Intrinsic Mode Functions (IMF) and the residue. Then, we will present some preliminary results of extracting human breath sound from white noises in a quiet environment using EMD. Finally, we discuss future work regarding detecting the sound of human breath from noisier environments.