

Abstracts of Presentations at the 2018 (128th) Annual Meeting of the Tennessee Academy of Science
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Poster Presentations

Agriculture

Farm to retail: A view into cost of production and retail margins in fresh strawberry. **Christian Smith***, **Omobolaji Omobitan***, **Aditya Khanal**, **Dharma Pitchay**, and **Ravi Ramasamy** Tennessee State University, Nashville, Tennessee. Strawberries are an important fruit crops for nutritional and economic values, ranking fourth most valuable fruit crops in the US. Over the past two decades, the US strawberry industry has grown production, consumption, and trade volume. Increased demand and consumption of strawberry in the US is attributable to increased awareness about the fruit consumption. However, there are several risks associated with producing strawberries commercially. This study reviews the cost of production of strawberry using information on components of production costs, yield and market prices from a number of secondary sources. Then evaluates profitability of production by computing average costs and retail margins across selected states. Based on findings, study discusses market margins and scope for day-neutral strawberries.

Where 'fun in the farm' is located in Tennessee? Examining agritourism location and structural factors. **Emmanuel Wallace***, **Ummey Honey***, **Aditya Khanal**, **Michael Crawford*** and **Omobolaji Omobitan***, Tennessee State University, Nashville, Tennessee. With recent development, agritourism—visiting a working agricultural setting such as farm and ranch for leisure, recreation, or education purposes is gaining popularity as a viable alternative to enhance income for farmers. Statistics show around \$600 million increase in agritourism-related receipts between 2002 and 2012 in the US. Studies suggest that proximity to urban/rural, structure-composition of consumer markets and amenities scores of a county could play a key role to start an agritourism operation. Tennessee is one of the states with increased agritourism operations in recent years. Using Zip-code level location information of agritourism farms in Tennessee, this study maps agritourism locations by activity and recreational services and examines role of structural factors in determining location.

Effects of compost rate and type of fertilizer for growth of petunia. **Abagayle Morton*** and **Anthony Witcher**, Middle

Tennessee State University, Murfreesboro, Tennessee, and Tennessee State University, McMinnville, Tennessee. Compost is used as a substrate for container-grown crops, but source and rate can affect crops. The objective was to evaluate two composts (vermicompost and vessel) and three fertilizers (starter, low controlled-release, medium controlled-release) for container-grown petunia. Petunia were transplanted into a standard substrate (80peatmoss:20perlite) or mixture of compost (10 or 30%) and pine bark (70 or 90%) amended with fertilizer. Substrate pH was lower in the standard substrate (5.2) compared with the compost (6.8 to 7.1). Substrate EC decreased over time except in the 30% compost. Shoot dry weight and flower number was greatest in the standard substrate, but similar among all composts. A compost/pine bark substrate can be used but a higher fertilizer rate is required for optimum growth.

Evaluation fertilizer type and compost rate for growth of vinca. **Alaina Kresovic*** and **Anthony Witcher**, Middle Tennessee State University, Murfreesboro, Tennessee, and Tennessee State University, McMinnville, Tennessee. Compost is used as a substrate for container-grown crops, but quality varies by source. The objective was to evaluate two composts (vermicompost and vessel) and three fertilizers (starter, low controlled-release, medium controlled-release) for container-grown vinca. Vinca were transplanted into a standard substrate (80peatmoss:20perlite) or mixture of compost (10 or 30%) and pine bark (70 or 90%) amended with fertilizer. Substrate pH was higher in compost (6.8 to 7.0) compared with the standard substrate (5.3). Substrate EC decreased over time but at a lower rate in the 30% compost. The standard substrate resulted in greatest shoot dry weight and flower number, but was similar among the compost substrates. When using a compost/pine bark substrate, a greater fertilizer rate must be used to maximize growth.

Gene expression studies per microRNAs profiles in the stem and leaf of sweet sorghum (*Sorghum bicolor* L.) as bio-fuel crop. **Binod Gyawali*** and **Ahmad N. Aziz**, Tennessee State University, Nashville, Tennessee. Sweet sorghum (*Sorghum bicolor* L.) is a C4 plant and considered as important bio-fuel crop due to high sugar content in its stems. MicroRNAs

(miRNAs) have been shown to play important roles regarding sugar accumulation traits. In order to analyze the miRNAs and their targets, we extracted total RNAs from the stems and leaves of two sweet sorghum varieties, i.e., 'Dale' and 'Topper 76-6' at the vegetative and reproductive stages. Later, topmost significant 36 miRNAs and their 18 targets were identified followed by the expressional analyses through quantitative polymerase chain reaction (qPCR). The identification of differentially expressed miRNAs and their targets as profiled in this report will help to reveal the molecular mechanisms controlling sugar accumulation in sweet sorghum.

Glyphosate resistant and susceptible horseweed seed germination rate and response to herbicide rate. **Christina S. Jennings*** and **Anthony L. Witcher**, *Tennessee State University, McMinnville, Tennessee*. Glyphosate resistant horseweed (*Conyza canadensis*) is a significant issue in nursery crop production. The objective is to identify a glyphosate resistant horseweed population, evaluate seed viability, and determine the effectiveness of glyphosate rate on resistant and susceptible seedlings. Two populations (resistant and susceptible) were identified, and plants were treated with glyphosate or glufosinate. Resistant plants survived glyphosate treatments and died following glufosinate, while all treated susceptible plants died. Germination results indicate that resistant seeds overall had higher viability. The whole-plant assay demonstrated resistant seedlings treated with glyphosate had similar shoot weight to non-treated seedlings. Each increase of glyphosate rate to susceptible seedlings marked a significant decrease in shoot weight. Overall, this indicates glyphosate resistance is readily inherited and resistant seedlings are more likely to survive.

Growth of *Andropogon gerardii* with 10-10-10 fertilizer. **Daniel Campos*** and **A. Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Grasslands such as those that contain *Andropogon gerardii*, big bluestem, in the Southeast U.S. are large enough to provide adequate habitats and nutrition for large animals. Given the cost and labor of applying fertilizer to maximize yield, is there an ideal amount of fertilizer to apply to this grass to maximize growth? This study examined the relationship between the growth of *Andropogon gerardii* with the addition of 10-10-10 fertilizer (nitrogen, phosphate, and potassium) to determine ideal growing conditions. The plants were grown for 3 months in pots containing different concentrations of fertilizer: 0.00g, 1.75g, 3.5g, and 5.25g. Plants were measured for growth in leaf length and dry-mass. Most growth occurred with the 3.5g fertilizer addition. Furthermore, the results indicate that growth depends on the fertilizer amount in correlation to size of pot. This study suggests that under- or over-fertilizing *Andropogon gerardii* can negatively impact growth.

Varying 10-10-10 fertilizer concentration for the optimal growth of Kentucky fescue (*Lolium arundinaceum*). **Nicholas Alexander*** and **A. Darlene Panvini**, *Belmont University,*

Nashville, Tennessee. Elk have been reintroduced into Tennessee and Kentucky in hopes of establishing new healthy herds. A main concern is if there are enough natural resources available to sustain a new population. Elk have been known to favor Kentucky fescue, *Lolium arundinaceum*, in all seasons as a nutritional source. Kentucky fescue is a grass that grows well in Tennessee regions, but little is known about how the plant responds to growth in varying concentrations of 10% Nitrogen-10% Phosphorous-10% Potassium fertilizer (10N-10P-10K) concentrations. In this experiment, Kentucky fescue was exposed to 0.00g, 1.75g, 3.5g, and 5.25g of 10N-10P-10K fertilizer in an attempt to see which concentration promoted optimal growth. Growth was measured by height and dry weight. The expected results are that 3.5g will promote the most height and heaviest dry weight. Results from this study can guide wildlife resource managers on how to best manage areas for maximum elk.

Fermentation of soybeans and ginseng by *Bacillus subtilis* Natto. **Fred Marino***, **Tony Johnston**, **Iris Gao**, and **Seockmo Ku**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Soybeans fermented by *Bacillus subtilis* Natto (BSN) have been a traditional food in Japan for thousands of years. BSN ferments soybeans via multiple exoenzymes and lipopeptides. When ginseng powder is combined with soybeans and then fermented with BSN it would be expected that ginsenosides would be bio-transformed into more active rare ginsenosides. Biotransformation of ginsenosides into rare ginsenosides can occur in the human large intestine and colon. The problem is that biotransformation and absorption have a limited time-period to occur. Our study will attempt the biotransformation of the ginsenosides that naturally exist, into the more bioactive rare ginsenosides. This would allow the absorption to occur throughout the entire human gastro-intestinal tract. The results of our study did show that the simultaneous fermentation of ginseng and soybeans did result.

Demographic background of the online student: the case for agriculture. **Jessica Crews Garcia**, **Joey Mehlhorn**, and **Rachna Tewari**, *The University of Tennessee at Martin, Martin, Tennessee*. It is important today to make education accessible to a broad range of people. There is increasing demand for online programs, especially for agriculture degree programs. Many people are unable to attend college due to work commitments. A full online degree program in Agribusiness was started in 2012 and continues to grow in student numbers. An assessment to determine factors that lead students to pursue online degrees was initiated in fall 2018. Results indicated that the majority of students could only complete their education online and work and family commitments are the leading factors. Since many students already have some college transfer credit, advising has become more involved. Issues related to recruitment and retention will be further developed when final results are summarized.

Producer input purchase decisions of agricultural products among variable size operations. **Austin Kendall***, **Joey Mehlhorn**, **Rachna Tewari**, and **Barbara Darroch**, *The University of Tennessee at Martin, Martin, Tennessee*. Research focused on factors that trigger producer input purchase decisions. The focus was to determine if there was any differences in preferences among farmers who have been farming for 0-10 years, 11-20 years and 20 plus years. With the 0-10 year farmers, firms need to focus on positioning quality inputs with price, delivery, and service after the sale. The 11-20 year farmers, input suppliers must focus on their business reputation and the education of their representatives while stocking reputable products, delivering quickly, and considering price and quality products. Input suppliers must focus on pricing input supplies to the 20 plus year farmers. Evidence quickly showed that price is one of the biggest influences in a producer's decision to purchase inputs from a supplier.

Seasonal abundance of pest insects and natural enemies of soybean in Middle Tennessee. **Kaushalya Amarasekare** and **Richard Link**, *Tennessee State University, Nashville, Tennessee*. Natural enemies play a significant role in suppressing both major and minor pest insects in many agricultural cropping systems. They are important in soybean integrated pest management (IPM). Although most pest insects of soybean in Tennessee are managed using insecticides, there are many natural enemies that exist in these cropping systems that could be well utilized in soybean IPM. We assessed the seasonal abundance of pest insects and natural enemies of soybean in 2016 and 2017 in Tennessee, using commercially available lures and sweep sampling for brown marmorated stinkbug monitoring, and sweep sampling for kadzu bug monitoring. Insect natural enemies were monitored using traps baited with herbivore induce plant volatiles and sweep sampling. The results are discussed.

Antibacterial activity of endophytic fungi isolated from Arkansas *Vitis aestivalis* (Norton / Cynthiana) Vegetative Tissue. **Kayley Stallings*** and **Tony Johnston**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Grape production in the US is a \$162 billion business. *Vitis vinifera* grapes are the predominant species in this industry but less than desirable growing conditions for these grapes predominate in the US, making it critical that alternative species be identified for maximal production. One species, *Vitis aestivalis*, is both drought and disease tolerant, making it an excellent candidate for widespread production. Previous research revealed that *Vitis aestivalis* (Cynthiana/Norton) contains fungal endophytes. Other plant endophytes have exhibited antibacterial properties; this project tested *V. aestivalis*' endophytes against bacteria known as problems in food preservation and general sanitation. Two of the endophytic molds (*Xylaria* and *Alternaria* or *Coniothyrium* sp.) exhibited inhibition against two of the bacteria tested and other fungi showed inhibition against one of the bacteria. The antibacterial activity is similar to other

researcher's results. Research is needed to test the remaining *V. aestivalis* endophytes and identify the antibacterial compounds produced.

Use of herbivore induced plant volatiles to monitor the seasonal abundance of green lacewings in tree-fruit orchards in middle Tennessee. **Kyle T. Williams***, **Kaushalya G. Amarasekare**, and **Richard H. Link**, *Tennessee State University, Nashville, Tennessee*. Green lacewings are important natural enemies of soft-bodied pest arthropods in many agricultural cropping systems including tree-fruit orchards. We investigated the seasonal abundance of *Chrysopa* and *Chrysoperla* species of green lacewings in tree-fruit orchards in middle Tennessee using HIPV lures [squalene and a combination of geraniol, methyl salicylate and 2-phenyl-ethanol]. The treatments were replicated four times and arranged in a RCBD. Weekly collections of liners showed two peaks of *Chrysopa nigricornis* populations in May and late-August. Due to this discovery, it is believed that *C. nigricornis* is bivoltine in Tennessee. We speculate that temperature plays an important role in the seasonal abundance of *C. nigricornis*.

Curiosity in agricultural classrooms. **Rachna Tewari**, **Isaac Lepcha**, **Chrissie Segars** and **Joey Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Curiosity has long been an intriguing topic among psychological researchers and a plethora of studies have explored the many benefits associated with it. It has been credited to enhance intelligence and perseverance, and can also compel individuals to make continuous efforts to fill the information gap in knowledge acquisition and its application. Based on the above premise and using prior literature, this study uses survey data to explore five specific dimensions of curiosity and to provide insight into differences in curiosity levels among students. Results could be expanded to further probe into the factors that affect curiosity and how practical application of learned concepts in the field of agriculture can enhance students' curiosity and stimulate learning both inside and outside of the classroom.

Student loyalty toward higher education institutions as influenced by experiential learning: perceptions of graduating seniors in agriculture. **Rachna Tewari***, **Barbara Darroch**, **Kevin Hammond**, **Bonnie Daniel**, and **Hui Chen**, *University of Tennessee at Martin, Martin, Tennessee*. Institutional success in higher education, as it pertains to retention and repurchase intention is critically determined by student loyalty. This study used a survey instrument comprising a Likert Scale tool to obtain graduating seniors' responses in the agriculture program at UT Martin. Standardized Cronbach alpha values decreased after removing the experiential learning variables from the construct. Removing student loyalty variables increased the standardized coefficient values indicating a low correlation with other variables in the construct that included both experiential learning as well as student loyalty parameters. Initial results indicate

that experiential learning and student loyalty are indeed separate constructs, and further research will be undertaken to determine reliability for each of the two scales.

Volatile profile of fruit juices by electronic nose. **Michael Addogoh* and Ramasamy Ravi**, *Tennessee State University, Nashville, Tennessee*. Consumers pay closer attention to food for its taste, aroma and appearance. Scientists have invented electronic sensing systems in food analysis to monitor food quality and authenticity. The main objective of this research is to explore the volatile profile of fruit juices using electronic nose (EN) and also to estimate the volatile profile of fruit juices using EN which in turn predicts the shelf-life of fruit juices on sale. Changes in volatile profile of fruit juices from production to storage are detected by electronic nose. Volatile profiles of fruit juices are subjected to PCA analysis indicated different clusters for different juices which can be stored as a library to compare with unknown samples. Enose is rapid technique to assess volatile profile of fruit juices to analyse freshness and predict shelf life.

The effectiveness of herbivore induced plant volatiles for monitoring field populations of *Orius insidiosus* and thrips in sweet pepper in Tennessee. **Uzoamaka C. Abana*, Kaushalya G. Amarasekare and Richard H. Link**, *Tennessee State University, Nashville, Tennessee*. Herbivore induced plant volatiles (HIPVs) are used as plant defensive mechanisms against insect herbivores. Thrips are a major pest of sweet peppers. *Orius insidiosus* is an important predator of thrips and other pests. We hypothesized that HIPVs is an effective method in attracting *Orius* and trapping thrips in cropping systems. The objective was to find the effectiveness of HIPVs to monitor field populations of *Orius* and their suitability as a pest management technique. Sweet pepper was the target crop with three experimental treatments; HIPVs [methyl salicylate (MS) and Neryl (S)-2-methylbutanoate (NMB)] and a no-lure control. This experiment was replicated using a RCBD. A moderate numbers of *Orius* and a significantly higher number of thrips were attracted to MS and NMB. This study shows that the use of HIPVs is a suitable method in attracting *Orius* to cropping systems and that the MS will be effective in the control of thrips.

A qualitative investigation of how mid and late career agricultural educators cope with job stress and burnout. **Jeffrey Sartain* and Will Bird**, *The University of Tennessee at Martin, Martin, Tennessee*. Career stress and emotional exhaustion have been linked to agriculture teacher burnout teacher attrition. This has created a shortage of qualified agriculture teachers. Solutions are needed if agriculture education is to continue to serve students in the future. The purpose of this investigation was to identify agricultural education "successful" at coping with career related. Four themes emerged as a result of qualitative analysis: *Understanding Sources of Stress, Knowing Your Limits, Love for the Job, and Administrative Support*. It can be concluded that teacher stress and burnout can be alleviated to some degree,

but is not altogether avoidable. It is recommended that teacher educators and school leaders adopt strategies to help early career teachers understand strategies for dealing with job stress.

Botany

Determining the presence of heavy metals in an intertidal grass species and seagrass species. **Kayla D. Howard* and LaRoy Brandt**, *Lincoln Memorial University, Harrogate, Tennessee*. The purpose of this research was to determine if using Electron Dispersive X-Ray Spectroscopy (EDX) through a Scanning Electron Microscope (SEM) could detect heavy metals in plant tissues from seagrasses and an intertidal grass species from the Northern Gulf of Mexico. Objectives included determining if plants occurring in submerged or intertidal habitats showed a difference in heavy metals present; as well as if species, individuals, or tissue type (root tips vs. leaf sheaths) varied. Results concluded that Aluminum, Cadmium, Mercury and Lead of the ten heavy metals chosen provided significant differences. However, percent variation between habitats (Al) and species (Cd, Hg, Pb) that were significantly different was largely unaccounted for. This did however show that EDX could be used as a relatively cheaper and quicker method for detecting heavy metals in plant tissue.

Observing potential synergistic and antagonist effects of acid and radiation stress on both invasive and native *Lonicera*. **Alexander P. Wharton* and A. Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Higher concentrations of UV-B radiation and more frequent occurrences of acid rain are apparent anthropogenic plant stressors. The effects of these pressures on Tennessee-native *Lonicera sempervirens* and the invasive *Lonicera japonica* are unknown. The purpose of this research is to observe the impact of these stressors on the two species of honeysuckle and the resulting synergistic or antagonist effects of the stressors when combined. The results showed no significant variation between the two species of honeysuckle. Individually, both acid stress and radiation stress demonstrated a reduction in the photosynthetic rates of both honeysuckle species. Subjects exposed to both stressors simultaneously demonstrated negative effects, but to a lesser extent than those exposed to a single stressor. In conclusion, anthropogenic UV-B radiation and acid rain have a negative impact on two common honeysuckle species in Tennessee, and the combination of the two stresses can be classified as a negative synergistic relationship.

Cloud forest epiphyte diversity, elevation and climate change. **Caitlin Barnes* and John Niedzwiecki**, *Belmont University, Nashville, Tennessee*. Climate change is lifting the cloudbank on tropical mountains, raising the elevational gradient of mist there. Here, I analyze the diversity, abundance, and richness of epiphytic plants along an

elevational mist gradient from 1540 m to 1800 m in elevation in the Monteverde Cloud Forest. A recent tropical storm created hundreds of recently fallen branches that were sampled for epiphytes. Fallen branches of 20 cm to 40 cm circumference and 0.5 m in length were collected and epiphytes were inventoried. Photographs of each branch were used to analyze percent bryophyte and lichen cover. Epiphyte abundance ($R^2 = 0.0089$, $p = 0.0036$), richness ($R^2 = 0.105$, $p < 0.001$), and diversity ($R^2 = 0.083$, $p = 0.0026$), showing a significant linear increase with elevation. Likewise, bryophytes increased ($R^2 = 0.17$, $p < 0.001$) while lichens decreased ($R^2 = 0.077$, $p = 0.043$). A 17% increase in bryophyte cover was coupled with a 15% increase in epiphyte richness, 17.7% in abundance, and 10.0% in diversity, all linked to elevation. These changes with elevation show that epiphyte communities at lower elevations, hence lower mist frequency, are simpler and less abundant. Mist frequency will continue to decline with the lifting cloudbank, causing losses in moss and epiphyte abundance, richness, and diversity.

Cell and Molecular Biology

Effect of brown recluse spider bite treatment on plasma membrane of epithelial cells. **Cord Beck***, **Christina Ross***, **Ashlyn Whittaker***, and **Amy Thompson**, *Austin Peay State University, Clarksville, Tennessee*. The brown recluse spider, *Loxosceles reclusa*, is a species of spider endemic to the southeastern United States. Brown recluse spider bites are known for their necrotic effects. Bite treatments may include antibiotics and anti-inflammatory drugs, although the effectiveness of these treatments is often questioned. In our work, we have observed that when cells are exposed to brown recluse spider venom, membrane damage typically occurs. This damage may lead to cell death. Dapsone, an antibiotic drug, and prednisolone, an anti-inflammatory drug, have previously been used to treat brown recluse bites. It is our hypothesis that dapsone and prednisolone will negate the effects caused by brown recluse spider venom in epithelial cells. We are concerned though that these treatments might cause their own cellular damage. In this study trypan blue staining, immunostaining, and toxicity screening were used to evaluate if prednisolone and dapsone negate the effects of the venom or actually further damage the cell membrane.

Detecting gluten in flour and foods using FDA approved gluten ELISA kits. **Olivia Calvert***, **Makayla Dixon***, and **Amy Thompson**, *Austin Peay State University, Clarksville, Tennessee*. Many people choose to eat a gluten free diet. Gluten free consumers rely on food manufacturers to accurately label food. Foods labeled gluten free, despite that they contain gluten or were processed in a factory that also processes wheat-containing products, present a major concern for people with Celiac disease and gluten intolerance. The Food and Drug Administration (FDA) provides

guidelines for labeling gluten free foods and identifies several approved gluten enzyme-linked immunosorbent assay (ELISA) testing kits. In this study, two gluten ELISA testing kits were evaluated for their effectiveness in detecting gluten in various flours and food samples. We hypothesized that the gluten testing kits will provide variable results in detecting gluten in flour and food samples. Additionally, we hypothesized that some foods, labeled gluten free, will contain gluten. The results of this study will be valuable for food manufacturers who are charged with accurately labeling foods as gluten free and for consumers who rely on accurate gluten free labeling.

Identification of a novel interaction between the centrosomal protein centriolin and the E3 ligase HectD1. **Alexander Garcia***, **Vancy Zora***, **Sean Dornbush***, **Zeynep Gromley**, and **Adam Gromley**, *Lincoln Memorial University-DeBusk College of Osteopathic Medicine, Harrogate, Tennessee*. Cytokinesis results in the separation of dividing cells at the end of mitosis. Earlier studies revealed that abscission, the final event of cytokinesis, was disrupted upon the reduction in the levels of a coiled-coil protein residing in one of the maternal centrioles of the centrosome, an organelle that is key to cell division. The ~270 kD centrosomal protein was classified as centriolin. Previous investigation conducted a yeast two-hybrid for determination of its molecular function and detection of potential centriolin interacting proteins. These studies demonstrated that HECT domain E3 ubiquitin protein ligase 1 (HECTD1), a protein that transfers polyubiquitin chains to its targeted substrates for degradation, exhibited binding at the N-terminal fragment of centriolin. The present study pursues confirmation of the centriolin-HECTD1 interaction in mammalian (HeLa) cell lysates by reciprocal immunoprecipitation for analysis by western immunoblotting at Gap 0 (G0), Synthesis phase (S), Gap 1 (G1) and Mitosis (M) of the cell cycle.

The effects of talcum powder on germline morphology and apoptosis in *C. elegans*. **Casey T. Kelly*** and **Julie Hall**, *Lincoln Memorial University, Harrogate, Tennessee*. Talcum powder is from the softest mineral on Earth, talc. Talc use in cosmetic products have been restricted due to carcinogen effects found through research. At different concentrations, talc can be found to be deleterious to certain mechanism in an organism. *C. elegans* were chosen as the model organism in the experiment. Growth assays were performed to determine concentrations in which the *C. elegans* growth was affected at 10% and 50% of the population. To determine the range of effect talc has on reproduction, L3-L4 nematodes were exposed to determined concentrations for 24 hours. The germlines were observed for presence of apoptotic cells and germline morphology. Preliminary data suggests an increase in cell death and an effect on the ability of the nematodes to properly lay the embryos. This research will provide valuable information on the effects of talc use, and open new ideas on dealing with reproductive disabilities.

Mitochondria localization during MDA-MB-231 cell migration *in vitro*. **Justin Lawrence*** and **Sarah Lundin-Schiller**, *Austin Peay State University, Clarksville, Tennessee*. Mitochondrial localization is important for cancer cell invasion into tissues. We seek to understand mitochondrial dynamics and organelle transport during chemotaxis in invasive MDA-MB-231 cells. The aim of the present study is to establish methods for using MitoTracker Green FM (MTGFM) in MDA-MB-231. Cells were grown in glass bottom 35 mm dishes for 48 hours and stained with MTGFM (100, 200, 300 nM) for 30 minutes. Laser scanning confocal images were obtained from four fields per dish per concentration and analyzed for mean intensity (NIS-Elements). Experiment was conducted on two culture passages. Mean ($n=8$) intensities were analyzed using ANOVA. Fluorescence intensity was found to be significantly different amongst the three concentrations ($P=.05$) with average intensities of 932.27 for 100 nM, 1371.79 for 200 nM, and 1080.07 for 300 nM. Thus, 200nM MTGFM was found to be optimal and will be used to localize mitochondria during MDA-MB-231 migration *in vitro*.

Effect of brown recluse spider venom on sodium channels. **Dillon C. Nall*** and **Amy Thompson**, *Austin Peay State University, Clarksville, Tennessee*. The brown recluse is a highly venomous spider that lives in close proximity to humans. Although it is rare, a bite from the brown recluse can cause skin necrosis and systemic symptoms. In this study, we have exposed the epithelial cell line MDA-MB-231 to brown recluse spider venom to look at voltage-gated sodium channels in the membrane. Our hypothesis is that the sodium channels are affected when cell membranes are exposed to venom. Twenty-four hours after venom exposure, we used a sodium channel antibody that is general for all sodium channel types along with fluorescent staining. We were able to show a change in the sodium channel position. Future studies will further investigate the location of these channels relative to the nucleus after exposure to venom to determine how and why the channels are being relocated within the membrane.

Fluorescent microscopy reveals apoptosis occurring in MDA-MB-231 breast cancer cells in response to brown recluse whole venom treatment. **Jerry Reed*** and **Amy Thompson**, *Austin Peay State University, Clarksville, Tennessee*. Breast cancer is one of the most common cancers in the world. The development of drugs to treat cancer is an ongoing pursuit. Many treatments originate from biologically active compounds found in organisms of the natural world. Arachnid venoms are rich in biologically active compounds that have been shown to cause cell death. Our hypothesis is that *Loxosceles reclusa* venom may be a viable option for inducing apoptosis in MDA-MB-231 breast cancer cells. This study demonstrates that *L. reclusa* spider venom yields cytotoxic effects to breast cancer cells often leading to cell death. Fluorescent staining shows characteristics that suggest apoptosis in MDA-MB-231 cancer cells

that are exposed to brown recluse spider venom suggesting that venom treatment may be a viable option for killing breast cancer cells.

Chemistry

Differentiation of ignitable liquids by using Direct Analysis in Real Time Mass Spectrometer (DART-MS). **Isabella Barnett*** and **Mengliang Zhang**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Quantitative analysis of Local Water Samples for Algal Toxin: Microcystin-LR. **Vishaka Motheramgari***, **Frank C. Bailey**, and **Mengliang Zhang**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Algal blooms created by nutrient runoff can cause a proliferation of cyanobacteria toxins in water sources. The aim of this project is to analyze water samples from various water sources in the Nashville area for the presence of the specific cyanobacterial hepatotoxin microcystin-LR. Fifty ml aliquots of water samples were acidified with 2% formic acid and then extracted using solid phase extraction (SPE). The SPE cartridge was conditioned with 15 ml of methanol followed by 15 ml of 2% formic acid aqueous solution. Samples were passed through the cartridges dropwise, cartridges were washed with 10 ml of water, and then eluted with 5 ml of methanol. Eluates were dried under a gentle nitrogen stream in a heated water bath and re-dissolved into 0.5 ml of methanol before analysis by liquid chromatography-mass spectrometry. Both environmental and spiked water samples were analyzed by the proposed method.

Antimicrobial activity of peptides. **Ahrang Yee**, **Purva Patel**, **Peter J. Ponce II**, **Allison N. Schmittou**, **Juan Soto**, **Alexis Alaya**, **Dr. Sergei Markov**, **Dr. Nsoki Phambu*** and **Dr. Rajalingam Dakshinamurthy**, *Austin Peay State University, Clarksville, Tennessee, and Tennessee State University, Nashville, Tennessee*. The structure, stability, and interaction of antimicrobial peptides with bacteria have been studied in order to discover bio-friendly antibiotics for pathogenic bacteria for the last decade. Most of these peptides inhibit the growth of bacteria via membrane damage. The scanning electron microscope (SEM) images of RW_4-NH_2 presented massive aggregates in the membrane mimetic vesicles during interaction with E.Coli. In order to understand the effectiveness of their antimicrobial activity, it is essential to determine the minimal inhibitory concentrations (MICs) of Gram-positive and Gram-negative bacteria. Two different types of antimicrobial peptides, Aurein 1.2 and RW_4-NH_2 were utilized to determine MICs for two Gram-negative bacteria, *Escherichia coli* and *Enterobacter aerogenes* and two Gram-positive bacteria, *Bacillus subtilis*, and *Staphylococcus aureus*. The amount of light absorbed by each bacterium culture with a different concentration of a peptide was measured by a spectrophotometer every hour for 6 hours. For Aurein 1.2, Gram-negative bacteria, *E.coli* and *E.aerogenes* showed lower MIC. Gram-positive bacteria,

B.subtilis and *S.aureus* showed higher MIC. For RW4-NH₂, Gram-negative bacteria *E.coli* and *E.aerogenes* also showed lower MIC. Gram-positive bacteria, *B.subtilis* and *S.aureus* showed higher MIC.

Cation exchange of chalcogenide nanocrystals using non-toxic starting materials. **Adekunle Titus Akinmola***, **Amadou Fall**, **Chen Lin**, and **P. Gregory Van Patten**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Quantum dots have unique optical properties that are useful for wide range of applications which include displays, bio-imaging and photovoltaic cells. The quest to synthesize new materials with great qualities ranging from size-tunability, photoluminescence quantum yield and storability using environment friendly materials have been the goal in nanotechnology. Absorbance peak from ZnSe in the UV-Vis region shifted in the Ag₂Se spectrum indicating a complete cation exchange. The particle morphology of Ag₂Se after a complete exchange and purification was confirmed from the XRD pattern. We have been able to carry out synthesis and cation exchange using relatively non-toxic material (ZnSe quantum dots) as our starting material.

Single-step synthesis of biofriendly gold nanoparticles. **Alexis Ayala**, **Juan Soto**, **Allison N. Schmittou**, **Peter J. Ponce II**, and **Dr. Rajalingam Dakshinamurthy**, *Austin Peay State University, Clarksville, Tennessee*. Uses of gold nanoparticles (AuNPs) have become more apparent within the biomedical fields by a multistep process of reducing and encapsulation with organic chemicals. The organic chemicals are used to maintain particle stability; however, they are not naturally occurring in the body nor are they biofriendly. Therefore, we have designed a single-step synthesis capable of using non-toxic reagents to reduce and encapsulate the AuNPs. Thus, ensuring the synthesized AuNPs are ecologically friendly and biologically safe. A monosaccharide (dextrose) and disaccharide (maltose) were both used as a non-toxic reducing and capping agent for the AuNPs. The synthesized AuNPs were characterized using UV-Visible spectroscopy, FT-IR, and TEM allowing for the size, shape, dispersity, and ligand presence to be confirmed.

Differentiation of ignitable liquids by using Direct Analysis in Real Time Mass Spectrometer (DART-MS). **Isabella Barnett*** and **Mengliang Zhang**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Ignitable liquids (IL) such as gasoline and kerosene are commonly used as accelerants in arson crimes, therefore IL identification is an important topic in arson investigation. American Society for Testing and Materials (ASTM) E1618 gas chromatography/mass spectrometry (GC/MS) method is often applied to designating samples into one of seven classes defined by ASTM. Ambient mass spectrometry methods such as direct analysis in real time mass spectrometry (DART-MS) can be alternative methods for IL identification which enable the direct sample analysis without chromatographic separation. Therefore, 10 IL samples were tested under different

conditions, including pure samples, weathered samples of varying degrees, samples diluted in solvents, and samples on a substrate, carpet. Mass spectra for different ILs were compared and characteristic ions or ion clusters were observed. In the current study the DART-MS has shown potential for the rapid screening of IL samples.

Single step synthesis of antibiotic oxytetracycline encapsulated gold nanoparticles. **Juan Antonio Soto**, **Purva Patel**, **Chloe Yee**, **Allison Schmittou**, **Peter Ponce**, **Alexis Ayala**, and **Dr. Rajalingam Dakshinamurthy**, *Austin Peay State University, Clarksville, Tennessee*. In recent years, bacteria have been rapidly evolving to become immune to antibiotics due to an increase in the use of antibiotics to prevent and treat bacterial infections. One solution to this pressing issue would be to determine new antibiotics, however, no new classes of antibiotics have been discovered for almost two decades. A simpler solution would be to modify and improve currently available commercial antibiotics to overcome the evolved characteristics of resistant bacteria. We propose modifying a current antibiotic, oxytetracycline, by using gold nanoparticles (AuNPs). Oxytetracycline belongs to a well-studied class of antibiotics and gold nanoparticles independently possess antibiotic qualities which have been shown to be successful for antimicrobial applications. Most AuNP synthesis procedures encounter disadvantages when considering the toxicity of the reagents used in the multi-step process. We propose a method of synthesis which is single-step, ecologically-friendly, and produces particles that are biologically safe.

GCMS quantitation of nicotine from electronic cigarette smoke collected using a student-built smoking machine. **Kristofer L. Conrad***, **Parth H. Patel**, and **Leslie A. Hiatt**, *Austin Peay State University, Clarksville, Tennessee*. With the increase in electronic cigarette (e-cig) usage and FDA regulations, this research seeks to quantitate the nicotine in both e-cig juice and vapors. Gas Chromatography Mass Spectrometry (GCMS) was used with quinoline as an internal standard to quantitate the nicotine in e-cig juice. This quantitation was compared with manufacturer labeling. Degradation with time and temperature was also examined. Additionally, the wattage, voltage, and resistance used to deliver e-cig juice is highly variable between e-cig manufacturers and users. GCMS analysis is being used to examine how e-cig juice content is related to the actual nicotine released during the vaping process. A simple apparatus was built to collect nicotine in simulated real-world use. These experiments increased the understanding of nicotine release during the vaping process and can be used to help organic students understand how GCMS can be used in extraction experiments.

Silicone microspheres: synthesis, characterization, and application. **Savannah Metheny***, **Logan Rahm***, **Robert Kenworthy***, **John Overcash**, and **Jen Esbenshade**, *The University of Tennessee at Martin, Martin, Tennessee*. The potential

biomedical applications surrounding controlled drug release and delivery of silicone microspheres synthesized using ultrasonic spray pyrolysis was explored. In this study, four silicone based polymers were reproduced from a recently published method and were characterized using SEM and swelling coefficients. The drug loading in various loading solvents and the release kinetics were measured using ibuprofen as a sample pharmaceutical. The process of synthesis of the microspheres using ultrasonic spray pyrolysis (USP), the apparatus development, current applications, and further directions for the use of silicone microspheres (SMs) in controlled drug delivery and as release agents will be explored. These studies will lead to a better understanding of tuning the characteristics of the silicone microspheres for the application of interest.

Synthesis of polymeric microspheres using ultrasonic spray photopolymerization. **Michaela Short*, Logan Rahm*, John Overcash, and Jen Esbenshade, The University of Tennessee at Martin, Martin, Tennessee.** Polymeric microspheres may be used in many practical applications. Often, the means of deriving microspheres from polymers requires curing at high temperatures. Photopolymerization using ultrasonic spray pyrolysis is a relatively cost and time efficient process by which these acrylate microspheres can be synthesized from UV-light sensitive adhesives with a narrow size distribution. In order to achieve sufficient yield of product, the apparatus and procedure for making these acrylate microspheres was optimized. The effects of the concentration of the light-sensitive adhesive in the precursor solution, the solvent used in the precursor solution, and the amount of time spent by the reactant in the illuminated region of the apparatus was investigated for the size and yield of product collected. The products made by this method were then characterized and analyzed using a scanning electron microscope.

Density functional model for nondynamic correlation optimization and benchmarking. **Matthew Wang*, Dwayne John, Jianguo Yu, Fenglai Liu, and Jing Kong, Middle Tennessee State University, Murfreesboro, Tennessee (MW, DJ; JY, JK), and Vanderbilt University, Nashville, Tennessee (FL).** The goal of this work is to benchmark the KP16/B13 (Kong-Proynov'16/Becke'13) functional for general applications of a wide range of molecular systems and demonstrate the viability of single determinant density functional theory (DFT) methods. KP16/B13 is a single-term density functional model that handles strongly correlated systems well. KP16/B13 was first optimized using a genetic algorithm for a general benchmark molecular set and atoms with fractional spin and charge. The result is a functional with comparable accuracy for these general molecules and better results for fractional properties. However, KP16/B13's performance for other molecular systems with specific properties remains untested. We test the performance of KP16/B13 and B13 on the Minnesota sets, composed of comprehensive chemical systems, to show the capability to handle broad molecular properties. The results are compared with contemporary

functionals such as B3LYP, M06, and B05. A software stack labeled GA_base (Genetic Algorithm base) facilitated the optimization, calculation, analysis, and organization of many molecular sets and functionals.

Quantitative analysis of local water samples for algal toxin: Microcystin-LR. **Vishaka Motheramgari*, Frank C. Bailey, and Mengliang Zhang, Middle Tennessee State University, Murfreesboro, Tennessee.** Algal blooms created by nutrient runoff can cause a proliferation of cyanobacteria toxins in water sources. The aim of this project is to analyze water samples from various water sources in the Nashville area for the presence of the specific cyanobacterial hepatotoxin microcystin-LR. Fifty ml aliquots of water samples were acidified with 2% formic acid and then extracted using solid phase extraction (SPE). The SPE cartridge was conditioned with 15 ml of methanol followed by 15 ml of 2% formic acid aqueous solution. Samples were passed through the cartridges dropwise, cartridges were washed with 10 ml of water, and then eluted with 5 ml of methanol. Eluates were dried under a gentle nitrogen stream in a heated water bath and re-dissolved into 0.5 ml of methanol before analysis by liquid chromatography-mass spectrometry. Both environmental and spiked water samples were analyzed by the proposed method.

Artificial neural network predictions of carbonyl reactivity and spectroscopic properties from a database of charge density descriptors. **Kiran K. Donthula* and Preston J. MacDougall, Middle Tennessee State University, Murfreesboro, Tennessee.** Carbonyl compounds are important to study because of their biological and industrial significance. A database of descriptors has been created for a range of aldehydes, ketones, imides, and amides. It is based on topological properties of the electron density, specifically for the carbonyl carbon's bond critical points and the maxima/minima in its valence-shell charge concentration. The artificial neural network (ANN) were trained to predict the experimental values of C13 chemical shifts and C=O stretching frequencies for molecules containing a carbonyl group. For a "stretch-test" we chose the E. coli enzyme D-fructose-6-phosphate aldolase (FSA), which catalyzes a nucleophilic addition reaction of a carbon nucleophile (ketone) to a carbon electrophile (aldehyde). The covalent interaction energy between a nucleophile and an electrophile within the binding pocket of an enzyme (FSA) is predicted by our ANN with an error of -3.2 kcal/mol (13.5 % error).

Ecology and Environmental Science

Biological survey of the interior coppice of San Salvador. **Dr. Dawn M. Ford, Jessica Wicker*, Laurel Jobe*, Nick Perry*, Stephanie Swart*, and Thomas Wiegand*, The University of Tennessee at Chattanooga, Chattanooga, Tennessee.** The purpose of this research was to conduct a biotic survey along a portion of an inland trail on Northeastern San

Salvador Island, Bahamas to contribute to the revision of the Bahamian Field Station Trail Guide published in 1994. This trail includes both terrestrial and marine habitats. Completed in March 2018, we aimed to compare plant and animal species composition and richness and water quality. The survey was conducted from Purslane Pit to the end of the trail at Osprey Lake. We hypothesized that species composition and richness would differ from the original trail guide, with a decline due to Hurricane Joaquin in 2015. Plant species observed were consistent with the trail guide's findings 25 years ago. Animal species in Oyster Pond were consistent with previous observations; further surveying is needed to identify all species present. An increased presence ammonia was present in all of the water sites tested.

Assessment of biodiversity relationships in turtle and leech parasite-host assemblages in middle Tennessee wetlands across a disturbance gradient. **Laura Horton* and William Sutton**, *Tennessee State University, Nashville, Tennessee*. Wetlands are being lost at an alarming rate due to anthropogenic disturbance. This has negative consequences for organisms, such as turtles, who rely on habitats these vulnerable ecosystems provide. Aquatic turtle biodiversity can be used to evaluate the condition of freshwater environments. Leeches, ectoparasites of turtles, can also serve as bioindicators in aquatic environments upon evaluations such as species richness between parasite and host. To better understand the effects of human influence on wetland turtles, wetlands across an anthropogenic disturbance gradient were sampled for turtle biodiversity, ectoparasites (leeches), and hematological measures for chronic stress. Over 6 months (May-October 2018) wetlands were sampled on four occasions per site, using 6 baited hoop-net traps deployed for 24 hours. Each captured turtle was weighed, measured, sexed, PIT tagged, examined for leeches, and blood-sampled. Collectively, the interpretation of these data can be used to understand the effects of anthropogenic disturbance on wetland turtle communities.

The effect of acidification on the antipredator behavior of the aquatic snail, *Elimia laqueta*. **Tanner Augello* and John Niedzwiecki**, *Belmont University, Nashville, Tennessee*. Aquatic species can use kairomones, chemical signals, to detect predators or food sources. Acidity may alter the ability to detect these signals. Acidification of aquatic environments can come from multiple sources, including in atmospheric carbon dioxide. In this study we asked the snail, *Elimia laqueta*, will be able to detect and respond to kairomone signals from predatory crayfish in acidified water. We used a two way design comparing frequency antipredator behaviors in normal (~7.7) and pH lowered (~6.7) stream water, and with and without predator cues in fish tanks. A two-way ANOVA showed statistically significant results for both pH and predator cues, but more importantly a statistically significant interaction term. Suggesting that antipredator behavior was significantly lower, or completely disappeared under slightly acidic condition. These results are

in line recent studies which show, small changes in pH can alter the sensory environments of aquatic predators and prey.

Characterizing and predicting site productivity using geocentric approach. **Mathew Purucker* and Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee*. Site productivity is a measure of primary productivity potential of a forest ecosystem. It is characterized by an interaction of biotic and abiotic factors such as climate, soil and topography. Accurate site productivity characterization allows for efficient land use allocation, integrated ecosystem planning, and prescribed ecosystem management. Better management of under-utilized woody biomass from forests could be a potential source of feedstock to meet the growing demand of biofuel production. We hypothesize that soil physical and chemical variables such as soil bulk density, effective cation exchange capacity (ECEC), macro and micro nutrient content, soil organic matter (SOM), carbon nitrogen ratio (C:N ratio) and pH will negatively impact forest site productivity. This study aims to pair Forest Inventory and Analysis (FIA) plot data with forest management history, and soil data along with standard climate, and topographic variables across the state of Tennessee to develop a geocentric model for evaluating site productivity.

The effects of steroid estradiol on growth and development of *Danio rerio*. **Mallory Arstikaitis* and Lori McGrew**, *Belmont University, Nashville, Tennessee*. In recent studies, it has been found that B-estradiol is present in natural water ways at concentrations ranging from 0.05 ppb to 0.10 ppb. Former studies have shown that these pharmaceuticals have a negative effect on the development and reproduction of aquatic organisms. The goal of this study was to determine the effect B-estradiol has on the growth and development of *Danio rerio*. The growth and development of the Zebrafish was assessed using eye measurements taken every 24hrs post fertilization for the duration of 5 days. The average measurements were then compared between treated and untreated. In this study, the difference in measurements were insignificant and it was concluded that at concentrations of 0.05 ppb and at the embryonic stage, B-estradiol had no effect on the growth or development of *Danio Rerio*. Future studies of a longer duration could examine the chronic effects of long-term exposure to β -Estradiol.

Use of pit tags in a mark-recapture study to assess survival and growth of two endangered freshwater mussels in the Powell River, Tennessee. **Jacob S. Lanning* and Aggy Vanderpool**, *Lincoln Memorial University, Harrogate, Tennessee*. In 2017, 120 endangered juvenile lab-propagated *Epioblasma Brevidens* and *Epioblasma Capsaeformis* were released at two sites on the Powell River in Tennessee, between river mile 85 and 97. The sites are divided into two linear transects that are twenty-meters long with the appropriate substrate and the flowing water required. All of the released mussels are equipped with a Hallmark tag for

visual confirmation and a PIT tag recorded by a portable PIT tag reader. The sites were checked bi-monthly as water temperature and flow allowed, to assess effectiveness of PIT tags for monitoring the growth and survival of the endangered mussels in an ongoing restoration effort. The field season is currently concluding and will finish in October, 2018. Sampling data will be compiled into a Bayesian model to assess recapture effectiveness, and changes in mussel size will be analyzed by analysis of variance.

The efficacy of bait-trap methods in butterfly monitoring in an urban park in Nashville, Tennessee. **Marcie Bulla*** and **A. Darlene Panvini**, Belmont University, Nashville, Tennessee. As urbanization expands, monitoring populations of indicator species in and around cities is increasingly important to assess the impact that urbanization has on the environment of remaining green spaces. As a pollinator with particular sensitivity to environmental disturbances, butterflies are one potential indicator species. However, most standardized butterfly baiting protocols are written for tropical and neotropical regions to attract fruit-feeding butterflies and do not offer direct guidance for bait-trapping methods in other regions of the world. This study assessed the efficacy of banana and nectar bait trap protocols in wooded and open field areas in an urban park in Nashville, Tennessee to determine if bait-trapping is a viable method for butterfly monitoring in this region. These results could serve as a guide for improving butterfly baiting methods in temperate regions of North America in order to facilitate the analysis of butterfly populations in other cities throughout the region.

Comparing carbon dioxide flux on a green roof and community garden in Nashville, Tennessee. **David Gustitus*** and **A. Darlene Panvini**, Belmont University, Nashville, Tennessee. The exchange of carbon dioxide (CO₂) between soil and the atmosphere affects the atmospheric carbon balance and is thus an important factor influencing climate change. In an era when climate change is becoming more perceptible, measuring soil flux of certain regions indicates how that region contributes to the overall carbon balance. Large cities are prevalent contributors to global pollution, but what is their role in influencing atmospheric CO₂? The increase in the number of green roofs in urban environments, combined with the decrease in undisturbed urban soils, could also affect the overall balance of soil carbon flux. The purpose of this study is to measure and compare the CO₂ flux on a green roof and a community garden located in Nashville, Tennessee for eight weeks with the LI-COR 8100A. Preliminary results suggest there is no significant difference between CO₂ flux between the green roof and community garden.

The effects of native and non-native plant species on CO₂ soil flux levels in relation to bacterial community diversity. **Samantha L. Rodriguez***, **George W. Bukenya***, and **A.**

Darlene Panvini, Belmont University, Nashville, Tennessee. Soil CO₂ flux can be a major contributor to atmospheric carbon. While various factors can affect CO₂ flux, the species of plants in the immediate area and the bacterial community can greatly determine carbon exchange between the soil and the atmosphere. The purpose of this project was to determine the levels of CO₂ released from the soil in the presence of native and non-native plant species. The Li-COR 8100A machine was used for weekly CO₂, temperature, and soil moisture measurements in an urban forest in Nashville, TN. for four months. BioLog Ecoplates were used monthly to determine microbial community diversity in the soil at the same location as the CO₂ flux measurements. The relationship between microbial diversity, presence/absence of exotic plant species, and CO₂ flux levels was determined. Results will be presented and discussed in the greater context of the impact of exotic species on carbon exchange and microbial diversity.

The use of green roofs by avian species and their preference in green roof characteristics. **Paige N. Ulrich*** and **A. Darlene Panvini**, Belmont University, Nashville, Tennessee. Green roofs in urbanized settings have become increasingly popular due to the numerous environmental and aesthetic benefits for humans and wildlife. Birds are one of the major urban wildlife vertebrates that show interest in using green roofs. The purpose of this project was to determine the green roof characteristics that birds prefer. Bird occurrences on three green roofs at Belmont University, Nashville, TN were determined through the use of wildlife cameras and in-person 20-minute observations. Individual bird occurrences, species, and behavior of birds landing on or near green roofs were recorded weekly for two months. Green roofs varied in size and plant species coverage. The larger green roof, with adjacent green roofs and more plant diversity, had the most bird visits. Results from this study can provide information for green roof designers seeking to maximize wildlife use of this urban green space.

Use of DNA barcoding as an effective tool in earthworm identification for diversity analysis in native and exotic plant plots. **Erin Laubacher***, **Bailee Powell***, **Chris Barton**, and **A. Darlene Panvini**, Belmont University, Nashville Tennessee. Soil dwelling organisms play a major role in supporting ecosystems by creating biomolecules necessary for life, and assessment of their diversity can indicate the health of ecosystems. There are over 6000 species of earthworms, many of which are still unknown. Earthworms have a high cryptic diversity and differentiating morphological characteristics arise only after sexual maturity, thus presenting a challenge in identifying juvenile individuals. In this study, DNA barcoding was used to identify earthworms in both adult and juvenile stages. Earthworms were collected from plots dominated by both native and exotic plants. DNA was isolated, sequenced, and compared to a database of gene sequences for species identification. DNA barcoding can be an effective tool for juvenile species identification and used in

conjunction with some morphological characteristics for future identification purposes. The correlation between plant biodiversity and earthworm diversity between all life stages will be noted.

Evaluating spatial ecology of Eastern Hellbenders (*Cryptobranchus alleganiensis alleganiensis*) in Southeast Tennessee. **Bradley D. Nissen***, **Emilly Nolan***, and **William Sutton**, *Tennessee State University, Nashville, Tennessee*. Successful translocation programs are dependent upon the quality of the habitats where animals are released, and a detailed knowledge of the species' spatial ecology needs. Due to population declines throughout its range, the Eastern Hellbender salamander (*Cryptobranchus alleganiensis alleganiensis*) is a strong candidate for translocation in Tennessee. We used radio-telemetry to evaluate the spatial ecology (i.e. home range size, habitat usage, and movements) of individual Eastern Hellbenders (N=27) in two sustainable populations to estimate suitable sites for translocations and to establish a baseline that can be used as a comparison with translocated individuals. Our preliminary results of this ongoing study show that most Hellbenders do not make frequent or large movements during summer months, and individuals spend most of their time under large (>30 cm) boulders. We conclude that boulders are a vital habitat requirement for translocation sites.

The functional roles of cattle and bison grazing in North American grasslands: a meta-analysis. **Caroline R. Wilford*** and **Jason L. Malaney**, *Austin Peay State University, Clarksville, Tennessee*. As conservation priority increases for grasslands due to anthropogenic causes, questions arise of the parity of ecological roles of dominant grazers. Bison (*Bison bison*) have historically played a keystone role in shaping grasslands and were replaced by domestic cattle (*Bos taurus*), thus raising concerns of their relative ecological roles. In this meta-analysis, we screen and quantify peer-reviewed studies from across prairie and montane ecosystems to compare functional roles of herbivores in grasslands. Cattle often have an increased affinity towards riparian and woody areas, and spend more time grazing. Bison wallows can influence local microhabitats and create landscape heterogeneity. More broadly, we detect insufficient information to thoroughly assess if grazing increases native biodiversity, but grazing pressure appears to increase abundance of deer mice and improve species richness of some native plants. We suggest room for development of additional research regarding ecological significance of shortgrass prairies, cascading trophic effects, and standardizing responses.

Effects of sub-lethal levels of antibiotics on the growth of freshwater algae. **Asia Gladney*** and **Matthew J. Heard**, *Belmont University, Nashville, Tennessee*. **Purpose:** Urban rivers have seen an increase in the introduction of antibiotics to their waters over time. While this is of growing concern because of the potential to impact freshwater species, there

has been limited research done to date to examine the impacts of these pharmaceutical introductions. **Objectives:** In this study, we examined how three common pharmaceuticals: penicillin, erythromycin, and tetracycline influenced the growth and survival of two common groups of freshwater algae: *Chlorella spp.* and *Euglena spp.* **Results:** In our study, we found that antibiotics significantly affected the growth and survival of both types of algae. However, we found no consistent trends between antibiotics and for our two algae species. **Conclusion:** Collectively, our findings indicate that antibiotics have the potential to impact the growth and survival of freshwater biodiversity in urban rivers. However, they also suggest that more work is needed to fully understand this issue.

Reptile diversity study on Kentucky Natural Lands Trust property. **Kiersten C. Dunaway*** and **LaRoy Brandt**, *Lincoln Memorial University, Harrogate, Tennessee*. The purpose of the study was to gain information on reptile diversity on untouched land. The overall objectives were to see and document the various species and their locations on the Thrasher Tract owned by KNLT. 40 Coverboards were placed at varying elevations along the mountain and data was collected once a week from April to the first of September. The results were not as expected at the beginning of the study. There was a total of 5 species seen. 4 of those were snake species and 1 was a lizard species. Most of the species were found on the higher/ upper elevation area of my research. Some conclusions drawn were that the upper section was more suitable for reptiles and more species are probably in the area.

Characterizing habitat use of a riparian-obligate songbird in agriculturally-dominated watersheds. **Nicole Santoyo*** and **Steven Hamilton**, *Austin Peay State University, Clarksville, Tennessee*. The Louisiana Waterthrush (*Parkesia motacilla*) is an insectivorous wood-warbler (Family Parulidae) that has been proposed as a bioindicator of stream conditions because it relies on relatively good-quality stream and riparian habitat in which to forage for both aquatic and terrestrial prey. In the Western Pennyroyal Karst (USEPA Ecoregion 71e) many streams are affected by agriculture, and I aim to characterize habitats available to waterthrushes therein, as well as what may limit their occupation of streams. To do so, I sampled macroinvertebrates, assessed stream and riparian habitat quality, and attempted to determine waterthrush presence by searching visually and aurally over 7 sites with a range of habitat degradation. While results are currently pending, I expect to find that waterthrush occupancy is positively associated with factors such as biotic integrity, surrounding land use, and riparian buffer width. Preliminary findings will be reported.

Examining the presence and abundance of microplastics in the Cumberland River in Nashville, TN. **Lina Said*** and **Matthew J. Heard**, *Belmont University, Nashville, Tennessee*. **Purpose:** Urban rivers are facing a growing threat from

microplastic pollution. However, there has been little research done in most rivers to examine how the presence and abundance of microplastics varies over time. Objectives: Here, we examined how microplastic pollution levels varied over a two-month period in the Cumberland River in Nashville, TN. In addition, we examined whether sites upstream and downstream of wastewater treatment plants, which have been listed as sources of microplastics had different levels of pollution. Results: We found that every water sample we collected across our sites had microplastics present. In addition, we found significantly higher levels of microplastics downstream of wastewater treatment plants. Conclusion: These findings indicate that microplastics are a threat in the Cumberland River. This finding is concerning because the Cumberland is a diverse ecosystem and because it provides drinking for the city of Nashville, TN.

Impact of invasive hydrilla senescence on nutrient availability, periphyton colonization, and macroinvertebrates in the Obed River Watershed, TN. **Sandra Bojić* and Steven Hamilton, Austin Peay State University, Clarksville, Tennessee.** Aquatic macrophytes are essential to the structure and function of freshwater ecosystems. Those with annual growth influence nutrient availability in the water between periods of growth when they decrease nutrient availability and senescence when they release nutrients. The invasion of *Hydrilla verticillata*, an exotic aquatic macrophyte that smothers streambeds with large biomass production, was discovered in the Obed River Watershed in August 2007. Commonly referred to as hydrilla, it experiences annual growth characterized by winter senescence of shoots. When considering its extensive growth, hydrilla's annual senescence has the potential to alter algal and associated invertebrate communities in response to nutrient influx. This study examines the effects of growing season on dissolved nutrients (phosphorous and nitrogen), algal colonization, and macroinvertebrate communities. I predict to see higher nutrient levels, higher periphyton biomass, and a shift in invertebrate functional feeding groups during periods of senescence relative to periods of growth.

Frequency of occurrence of native planktivorous fishes in relation to the establishment of bigheaded carps. **Maria S. Brauer, Jennifer T. Thomas, and Jennifer M. McBride, Belmont University, Nashville, Tennessee (MSB and JTT), and Southern Illinois University, Edwardsville, Illinois (JMM).** Over time, river systems have gone through natural changes but also endured anthropogenic alterations and influence. The Upper Mississippi River System (UMRS) has long been an important resource for humans and fishes. To understand how the UMRS has changed temporally, we explore the river's fish community compositions before and after the introduction of bigheaded carps (*Hypophthalmichthys molitrix* and *Hypophthalmichthys nobilis*). Carps easily overpopulate and invade backwater lakes, side channels and main channels, impacting habitat and food availability of native taxa. Species recorded in archaeological data were

compared to modern fish sampling data to gauge the effect of bigheaded carp in the UMRS. The archaeological species differed from modern species in terms of overall absence and presence. The modern data did not show temporal changes with the introduction of carp compared with post carp periods. Additional analysis such as relative abundance may help us further document other factors influencing this data.

Health and Medical Sciences

Epidemiology of foodborne disease outbreaks in Tennessee and the United States: analysis of CDC National Outbreak Reporting System data of 1998 to 2016. **Anita Scales*, Monica Henry, and Aliyar Fouladkhah, Tennessee State University, Nashville, Tennessee.** Foodborne diseases could affect healthy individuals and more severely at-risk groups such as the very young, the elderly, pregnant women, and the immunocompromised. It is estimated that around 30% of US population are currently considered as at-risk for foodborne diseases. Recent epidemiological estimates of the Centers for Disease Control and Prevention indicate as high as 1 in 6 Americans experience foodborne diseases every year, leading to more than 127,000 episodes of hospitalizations and around 3,000 deaths. From 1998 to 2016, there have been more than 19,900 single or multistate outbreaks leading to about 380,000 illness with 4% rate of hospitalization. Information derived from active surveillance data of the Centers for Disease Control and Prevention from 1998 to 2016 were analyzed and will be presented in the current poster. Particular emphasis has placed on comparison of Tennessee-related food safety outbreaks, illnesses, hospitalizations, and death episodes as related to national statistics.

Effects that sleep has on mental health in college science students. **Heather Herring*, Joseph Daft, and Pamela Hobbs, Lee University, Cleveland, Tennessee.** College students can suffer from lack of sleep for reasons such as sleep deprivation (psychological or behavioral) or sleep disorders (most common being insomnia, obstructive sleep apnea, or restless leg syndrome). Psychological disorders are becoming more common in our society- with college campuses being adversely affected. This study will investigate the correlation between sleep and mental health in science students at Lee University. Anonymous surveys will be used to measure a student's mental health and sleep patterns. Surveys will be distributed to several classes within the Natural Sciences and Mathematics Department at Lee University. The information obtained from the survey will determine the relationship between the amount of sleep our science students get and mental health.

Investigating the moral compass of the dietetics profession: The Professional Code. **Terra L. Smith and Loveday E. Nwobilor, The University of Memphis, Memphis, Tennessee and Shelby Residential and Vocational Services, Inc. Memphis, Tennessee.** Allied health care professionals have a

responsibility to do no harm while caring for others. Since World War II professional morals have been articulated in codes. The purpose of the project is to investigate, from an international perspective, the nature of professional codes constructed in dietetics. In order to retrieve professional codes, an internet search of select search engines and databases was conducted focusing on relevant key words and phrases. Professional codes (n=14) were retrieved for dietetic associations representing 5 cultural clusters. The frequency of key words and related words in the first three tiers of the codes revealed the core values of global dietetic associations. The study highlighted the need for future investigations on dietetic codes in relationship to expressions of key dimensions of scholarship, the ethic of care as well as the relations between and types of codes (i.e., ethics versus conduct or dietetics versus nutrition).

History of Science

Contributions of early MTSNS faculty in establishing the Tennessee Academy of Science. **Hunter D. Hudson*** and **Martin V. Stewart**, *Middle Tennessee State University, Murfreesboro, Tennessee*. The contributions of early faculty members in helping to establish the Academy are summarized in this project. Biographies for each were constructed through archival research from the Special Collections Room of the Walker Library and Albert Gore Research Center of MTSU, the Linebaugh Library and Rutherford County Archives in Murfreesboro, and digitalized historic newspapers available online. Chronologically, the faculty featured are Archibald Belcher, Jeanette King, Verd Peterson, and William Mebane. Our project extends through 1943, when Dr. Mebane left the campus to join the war effort as a naval officer. History demonstrates that the tendency of the science faculty of MTSU to engage in outreach activities began during the earliest days of the institution and helped to prevent its isolation. Thus, our project tends to clarify the vaguely documented beginnings of MTSU. Support from the Undergraduate Research Experience and Creative Activity (URECA) grant from the College of Basic and Applied Sciences of MTSU is gratefully acknowledged.

Mathematics and Computer Science

The three terrible Ws of West Indian cricket: probability, statistics and cluster analysis. **Arjun Tan and Marius Schamschula**, *Alabama A & M University, Normal, Alabama*. The Three Ws of West Indian cricket of Worrell, Weekes and Walcott have been labelled as the rarest event in cricket history. The batting careers of the Three Ws were nearly identical and their batting statistics were unusually similar. For qualitative attributes, the resemblance coefficient between the Three Ws were all above 93.33%. For quantitative attributes, the resemblance coefficient between

the Three Ws ranged from 87.55% to 91.69%. The magnitudes of the highest scores of the Three Ws were within 3% of one another; and they were all unbeaten, the probability of which is estimated at 3.7%. The probability that the Three Ws were all born in Barbados and had surnames beginning with W is estimated as 7.41 in a million! A cluster analysis using quantitative attributes shows that Weekes and Walcott cluster first, followed by Worrell.

Modeling vibrations of a guitar string using the one-dimensional wave equation. **Tamara Niccum***, **Michael Harris***, and **Daniel Mayo**, *Austin Peay State University, Clarksville, Tennessee*. We will model the vibrations on a guitar string that result from an initial displacement. The model will initially examine the undamped case in which the guitar string experiences no air resistance or non-elastic effects in the string. Next, we include a dampening term to more accurately approximate real-world conditions. We will model the vertical displacement of the string as a function of time using two methods. The first will use Mathematica code based on a Trigonometrically Fitted Block Numerov Type Method. The second method will use a recursive Finite Difference technique with Excel software. The approximation error for both methods will be compared.

Approximating solutions to the nonlinear Schrodinger equation. **Zane Celmer*** and **Daniel Mayo**, *Austin Peay State University, Clarksville, Tennessee*. The nonlinear Schrodinger equation can be used to describe systems in which propagating light encounters nonlinearities within a medium. For example, light propagating within a fiber optic cable can encounter dispersion effects since the refractive index of the fiber is partially dependent upon the intensity of the light. Two methods will be used to approximate solutions to the nonlinear Schrodinger equation. The first approach will utilize Mathematica code with a Block Hybrid Backward Differential Method of Step 2 and a Polynomial Basis. The second will use a simple iterative Finite Difference method using Excel software. A comparison of the approximation error for both numerical methods will be discussed.

Modeling the thermal transfer of sparklers using the heat equation. **Latoria Brown***, **LaQuinton Dunn***, and **Daniel Mayo**, *Austin Peay State University, Clarksville, Tennessee*. For decades sparklers have been used to celebrate important occasions. Sparklers consist of a simple wire coated with a mixture of metallic elements and oxidizers that produce a series of sparks when ignited. The temperature of a sparkler typically exceeds 1000°C. We will model the temperature distribution along the sparkler as a function of time using two methods. The first will use Mathematica code based on a two-step Block Backward Differentiation Formula. The second method will use a simple Finite Difference technique with Excel software. A comparison of both the approximation error and ease-of-implementation of the methods will also be presented.

Microbiology

High pressure pasteurization against O157 and Non-O157 Shiga toxin-producing *Escherichia coli*. **Abimbola Allison***, **Shahid Chowdhury**, and **Aliyar Fouladkhah**, *Tennessee State University, Nashville, Tennessee*. Various serogroups of Shiga toxinogenic *Escherichia coli* (STEC) are responsible for approximately 176,000 illnesses, 3,700 hospitalizations, and 30 deaths in the US annually. Hydrostatic pressure of up to 650 MPa were applied at various time intervals for inactivation of six-strain mixture of wild-type O157 STEC and six-strain mixture of O26, O45, O103, O111, O121, O145 STEC as well as their spontaneous rifampicin-resistant phenotypes. Wild-type O157 STEC were reduced ($P < 0.05$) from 7.16 ± 0.1 to 5.41 ± 0.2 when exposed to treatments at 350 MPa for 7 minutes. Reductions of rifampicin-resistant non-O157 STEC were similar to their spontaneous wild-type phenotype. Results of this study indicate pressure-based pasteurization could appreciably enhance decontamination efficacy of ground meat against Shiga toxin-producing *Escherichia coli*. The rifampicin-resistant and wild-type phenotypes of both O157 and non-O157 STEC showed similar sensitivity to elevated hydrostatic pressure thus could be used interchangeably in microbiological challenge studies.

Effect of ECIG-generated aerosol and conventional cigarette smoke on the planktonic growth of commensal oral bacteria. **John Nelson***, **Micah Shook**, **Joshua Lewis** and **Dominic Palazzolo**, *Lincoln Memorial University, Harrogate, Tennessee*. All surfaces of the oral cavity are covered by commensal bacteria, which act as a layer of protection from the external environment, including cigarette smoke and ECIG-generated aerosol. Experiments were designed to compare the effect of aerosol (+/- nicotine) and smoke on the planktonic growth of four strains of oral commensal streptococci (*S. gordonii*, *S. intermedius*, *S. mitis*, and *S. oralis*). The results indicate that E-liquid (+/- nicotine) has little or no effect on bacterial planktonic growth as indicated by 24-hour growth curves. In contrast, cigarette smoke dramatically reduces planktonic growth of all bacteria. These results suggest that, unlike ECIG-generated aerosol, cigarette smoke has a profound effect on the growth of all oral commensal streptococci tested.

Examining the presence of antibiotic resistant *Escherichia coli* in Nashville, TN's Cumberland River. **Rachel Hongo*** and **Matthew J. Heard**, *Belmont University, Nashville, Tennessee*. The introduction of antibiotics to rivers is driving the emergence of antibiotic resistant bacteria. Assessing the scope of this problem is challenging because we often lack information on how commonly we find antibiotic resistant bacteria in many rivers. Here, we examined how often we find resistant bacteria in the Cumberland River, in Nashville, TN. To do this, we collected water and sediment samples in summer 2018 and looked for signs of resistance to eight different types of antibiotics in a common bacteria –

Escherichia coli. We found that antibiotic resistance was common in bacteria collected from both the water and the sediment. In addition, when we found *Escherichia coli*, it always showed resistance to multiple antibiotics. Our findings indicate that antibiotic resistance emergence is occurring in the Cumberland River. However, they also indicate that more work is needed to understand this issue.

Kinetic analysis and epitope mapping of monoclonal antibodies to *Salmonella typhimurium* flagellin using a Surface Plasmon Resonance biosensor. **Devendra Bhandari*** and **Fur-Chi Chen**, *Tennessee State University, Nashville, Tennessee*. Surface Plasmon Resonance biosensors (SPR) and ELISA utilize monoclonal antibodies (mAb) for detection of *Salmonella typhimurium*. However, due to insufficient information on the nature and position of antibody binding with *S. typhimurium* flagellin, selection of appropriate antibody for the assay is one of the cumbersome job. Hence, we aimed to compare binding kinetics of four mAb and their relative binding sites to flagellin, using SPR biosensor. Initially, flagellin was captured on mAb 1E10 immobilized sensor surface. For binding kinetics, four concentrations of each of the four mAb were injected sequentially. For epitope mapping, five mAb were injected in pair to determine inhibition of one mAb on other. It was found that four mAb differed significantly ($p < 0.05$) in terms of association rate, dissociation rate and equilibrium dissociation constant. Additionally, pairwise epitope mapping suggested four different epitope maps in flagellin. Researchers can use these results to select mAb while performing immunoassays.

Prevalence and antimicrobial susceptibility of pathogenic and indicator bacteria in edible offal and muscle meat retailed in Nashville, Tennessee. **Siqin Liu*** and **Agnes Kilonzo-Nthenge**, *Tennessee State University, Nashville, Tennessee*. The consumption of edible offal has witnessed a tremendous growth worldwide. This study investigated the antimicrobial resistance of bacteria from edible offal and muscle meats. A total of 348 meats were analyzed for microbial contamination by biochemical and molecular techniques. *Salmonella* (4.4 and 4.3%), *Campylobacter* (1.9 and 1.1%), *E. coli* (79.4 and 89.4%), and *Enterococci* (88.1 and 95.7%) were identified on edible offal and muscle meats, respectively. No *E. coli* O157:H7 was isolated. Resistance was significantly ($P < 0.05$) higher in erythromycin (98.3-99.1%), tetracycline's (94.0-98.3%), and vancomycin (88.8-92.2%) as compared to chloramphenicol (43.1-53.9%), amoxicillin/clavulanic (43.5-45.7%), and ciprofloxacin (45.7-55.7%). Imipenem showed the lowest resistance (0-0.9%). Edible offal and muscle meats are contaminated with resistant bacteria, hence a risk to human health.

Investigating the possible correlation between microplastic abundance and the presence of *Escherichia coli* in the Cumberland River. **Chandler Phelps*** and **Matthew J. Heard**, *Belmont University, Nashville, Tennessee*. Recent research has suggested that microplastic pollution can facilitate the

growth of bacteria. However, little work has been done to examine if this is occurring in ecosystems that are polluted with microplastics. To examine this, we conducted an observational study in the Cumberland River in Nashville, TN to determine if microplastic abundance was correlated with the abundance of a common bacteria - *Escherichia coli*. We also conducted an experimental study to examine how the abundance of microplastics influenced the growth of *Escherichia coli* colonies collected from the river. For the observational study, we found no significant correlations between microplastic and bacteria abundance. However, using the experimental approach, we determined that there was a significant positive correlation between microplastic abundance and bacterial growth. Our findings indicate that increasing levels of microplastics could increase the abundance of bacteria. However, more work is needed to fully understand this issue.

Comparison of antibacterial properties in selected plant parts of *Spigelia marilandica*. **Sarah E. Crossan*, Jennifer Thomas, and A. Darlene Panvini**, Belmont University, Nashville, Tennessee. *Spigelia marilandica*, a Missouri native and Tennessee residing perennial, has been used by Native American tribes for hundreds of years for its presumed antibacterial, anti-inflammatory, and antihelminthic properties. Little research has been done in order to scientifically support these medicinal benefits. This study tested the hypothesis that extracts from the roots, stems, and leaves of *Spigelia marilandica*, commonly used to treat the symptoms of bacterial infections, would show antibacterial properties. Two gram positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, and two gram negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*, were chosen due to their potential medicinal implications, with the gram positive bacteria expected to be more greatly inhibited. Ampicillin was used as a positive control. This study will allow for a greater understanding of one of the most extensively used plants among the Cherokee tribes.

Characterization of a novel *Clostridium difficile* virulence target: A structural biology approach. **Isria C. Jarrett*, Heather K. Kroh, Darlene Panvini, and D. Borden Lacy**, Belmont University, Nashville, Tennessee (ICJ, DP), and Vanderbilt University, Nashville, Tennessee (HKK and DBL). *Clostridium difficile* is a gram-positive bacterium associated with the nosocomial disease *C. difficile* infection (CDI) which causes inflammation in response to sporulation and toxin secretion. Incidence and recurrence of CDI have increased dramatically in immunocompromised and elderly patients. Studies have targeted these toxins for immunotherapy methods. However, proteins on the surface of and within *C. difficile* could provide new, more efficient targets for prevention of disease. This study examined the uncharacterized *C. difficile* protein C9YJI8 using structural methods to identify potential functions. The objective was to recombinantly express, adequately purify, and obtain refined protein crystals for X-ray diffraction analysis. Protein

crystals were obtained but more optimization methods are needed for better isolation of crystals. This structural approach will aid in understanding the protein's potential role in bacterial survival or virulence, provide new information about the mechanisms involved in the virulence of *C. difficile*, and guide new immunotherapeutic treatments for CDI.

Variance and antimicrobial properties in soil bacteria among native and exotic plant species in Nashville, Tennessee. **Adria Payne*, Britney Sams*, Jennifer Thomas, and A. Darlene Panvini**, Belmont University, Nashville, Tennessee. Within the last century, humans have serendipitously discovered antibiotics, exploited their properties, and now entered into a period where their efficacy is waning. Due to the high adaptability of bacterial species to become resistant to medication and the high costs associated with antibiotic research and development, many pharmaceutical companies no longer research antibiotics. This project uses the principles and procedures established by the Small World Initiative to explore soil bacterial strains for potential antibiotic properties. Soil samples were collected from underneath exotic and native plants, diluted in water, and plated to extract bacteria. Fifteen bacteria from each soil type were cultured and assessed for their antibiotic properties against two gram positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, and two gram negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*. Results will be presented and discussed in the context of the importance of isolating and identifying bacterial strains with antimicrobial properties.

Physics and Astronomy

Dolidze-35: A study of under-observed galactic star clusters: **I. Jamin Welch*, J. Allyn Smith, Deborah J. Gulledge, Elizabeth Juelfs, H. Hope Head, Douglas L. Tucker, and Sahar S. Allam**, Austin Peay State University, Clarksville, Tennessee (JAS, JW, DJG, EJ, HHH), and Fermilab National Accelerator Laboratory, Batavia, Illinois (DLT, SSH). Dolidze-35 is an under-observed northern hemisphere open cluster. It is noted in WEBDA as "No data available for this cluster". As such, we chose this cluster as an undergraduate class project to investigate its existence. We present *photometry* for suspected member stars including membership probability in conjunction with *GAIA's Data Release 2*. We will also present the standardized magnitudes for member stars.

'Special Theory' of Gabbard diagram formation for satellite fragmentation in a circular orbit. **Arjun Tan, Robert C. Reynolds, and Marius Schamschula**, Alabama A & M University, Normal, Alabama (AT, MS), and STAR Dynamics, Hilliard, Ohio (RCR). The Gabbard diagram is widely used in satellite fragmentations in orbit. For a fragmenting satellite in a circular orbit it has the shape of

an inclined 'X'. The data points lie above and below the arms of the X. The space between them, devoid of fragments consists of the 'forbidden zone'. The envelopes of the data points have the shapes of hyperbolas with the arms of the X as the asymptotes. In this study, a 'Special Theory' of Gabbard diagram formation for satellite fragmentation in a circular orbit is presented based on Lagrange's planetary equations. It reproduces all the characteristic features mentioned above including the 'X' form, the smear of fragments above and below the 'X', the forbidden zones and the equations of the hyperbolas and their asymptotes.

'General Theory' of Gabbard diagram formation for satellite fragmentation in an elliptical orbit. **Arjun Tan, Robert C. Reynolds, and Marius Schamschula**, Alabama A & M University, Normal, Alabama (AT, MS), and STAR Dynamics, Hilliard, Ohio (RCR). The Gabbard diagram is widely used in satellite fragmentations in orbit. In the case of a satellite fragmentation in a general elliptical orbit, the Gabbard diagram strongly depends upon the eccentricity of the orbit and true anomaly of the fragmenting satellite. Unlike fragmentations in circular orbits, the apogee and perigee lines do not intersect unless extended. As the true anomaly at fragmentation is varied between 0 and π , the slope of the apogee line decreases while that of the perigee line increases. In this study, a 'General Theory' of Gabbard diagram formation for satellite fragmentation in an elliptical orbit is presented based on Lagrange's planetary equations. The slopes of the apogee and perigee lines are obtained and the condition of parallelism of the lines determined. The theory reproduces the different cases of Gabbard diagram depending upon the true anomaly of the fragmenting satellite.

Thermal stability and crystallization of Bi and P modified chalcogenide glasses. **Margaret J. Seage* and Roman Golovchak**, Austin Peay State University, Clarksville, Tennessee. High optical transparency, large optical nonlinearities excellent molding and fiber drawing capabilities, sensitivity to the external factors make chalcogenide glasses very appealing materials for various applications in modern electronics and photonics. Tellurium- and selenium-based compositions can be further modified with the elements like Bi and P to achieve thermoelectric effect, n conductivity type, rapid crystallization at elevated temperatures or under photoexposure. In this work we report the thermal stability and crystallization kinetics studies for Bi-P-Ga-Ge-Se-Te glasses, with P content up to 10 at.%. Our results show that as the concentration of P increases in the composition, the thermal stability of glass also increases. Conversely, if Bi concentration increases, thermal stability of the glass decreases and rapid crystallization peaks are observed with differential scanning calorimetry. The latter property can be used for phase-change memory applications.

Science and Math Teaching

UT Martin greenway geological display for Earth science laboratories and public education. **Joseph Pelren* and Michael A. Gibson**, Westview High School, Martin, Tennessee (JP) and The University of Tennessee at Martin, Martin, Tennessee (MAG). West Tennessee has few natural rock exposures. We created an artificial rock outcrop along a greenway on campus that serves as an alternative to extensive travel to outcroppings. The site mimics natural rock formations that demonstrate deformation, and can be used to establish geologic histories and landscape features. Large slabs of limestone, sandstone, granite, schist, and gneiss were donated by Mulch and More Landscaping. Installation was carried out as part of an Eagle Scout project by the first author, with much of the labor completed by a local Boy Scout troop. Signage is provided by the University. Geology classes at UT Martin, along with a dual enrollment geology course at a local high school, use the site for geology field trips. As the site is along a public greenway, it is also providing educational opportunities to all users of the trail, including the residents of Martin and local school groups.

Comparing undergraduate biology majors outlook on science to that of undergraduate non-majors. **Alegha R. Carroll* and Stanton G. Belford**, Martin Methodist College, Pulaski, Tennessee. Understanding undergraduate student interests and attitudes in science can assist with the development of science inquiry activities, which can change the overall perception of how students view scientists. We surveyed freshman in a general biology course for non-majors, and compared these results to undergraduate biology majors. We also administered the Draw-a-Scientist Test (DAST) to determine students' perception of scientist using visual images. For non-majors and majors, students agreed that it is important to understand the scientific process, however non-majors disagreed that biology was interesting, or fun to them. In comparison, biology majors strongly agreed that biology was interesting, fun, and enjoyable. The DAST showed non-majors perception of scientists as typically wearing a lab coat and eyeglasses, compared to biology majors whom had low responses. Interestingly, biology majors drew more women scientists (32%, $n=43$). Identifying attitudes can be used to highlight deficiencies in science inquiry, specifically related to student interests.

Zoology

Seasonal differences in bat species diversity and activity at the Beech Ridge Unit of the Obion River Wildlife Management Area. **Aubree Weitzel*, Jeremy Dennison, and Nancy Buschhaus**, University of Tennessee at Martin, Martin, Tennessee (AW, NB) and Tennessee Wildlife Resources Agency, Region 1, Jackson, Tennessee (JD). Most species of bats in Tennessee use the forested landscape as roosting

habitat to raise their offspring and forage during the summer months. We examined the variation in bat use of an ephemeral wetland site located in the Beech Ridge Unit of the Obion River WMA June-September 2018 with mist net and acoustic surveys. We physically captured, identified, and measured bats approximately every 3 weeks over the summer months and in to early fall. Simultaneously, we used full-spectrum bat detectors to record bat activity and species richness at the site for at least two weeks per month. During the study, the ephemeral wetland dried and insect diversity changed with a correlated change in bat species diversity and activity.

Correlation of bat species richness and bat activity with habitat type, insect diversity, and insect biomass at Reelfoot Lake. **Parker Blayne Judkins***, **Jack Grubaugh**, and **Nancy Buschhaus**, *University of Tennessee at Martin, Martin, Tennessee*. We examined the correlation between habitat type, insect diversity, and insect biomass at Reelfoot Lake, June 20–August 15, 2018, to determine if the activity of different species of bats would be correlated to these factors. We simultaneously sampled three habitat types (two sampling sites each located in bottomland hardwood forest, lakeshore habitat, and cropland) each week with bat detectors. Two nights a week at each site, we collected insects using black light traps, identified insects to order and family (where possible), and determined biomass. Beetles (Order *Coleoptera*) and water boatman (Family *Corixidae*) had a greater abundance over the other insect orders and families in the crop habitat than they did in bottomland hardwood and lakeshore; at those latter habitats, moths (Order *Lepidoptera*) were the most abundant. In turn, bat species richness and bat activity were correlated to habitat type, insect diversity, and insect biomass.

A preliminary examination of the microbiome of bat feces from a White Nose Syndrome negative site. **Georgia Casio***, **James Smart**, **Jeremy Dennison**, and **Nancy Buschhaus**, *University of Tennessee at Martin, Martin, Tennessee (GC, JS, NB) and Tennessee Wildlife Resources Agency, Region 1, Jackson, Tennessee (JD)*. White nose syndrome (WNS), an emergent disease caused by the fungus *Pseudogymnoascus destructans*, has been decimating populations of hibernating bats for the last decade in Tennessee. Although several studies have compared the relationship between the skin microbiome of bats with or without WNS, there are few characterizing the gut microbiome of bats from WNS affected areas. We isolated bacterial DNA from fecal samples of bats from a WNS- habitat and characterized the gut microbiota of bats using NGS in this preliminary study.

Island-inhabiting voles have larger skulls than their mainland relatives: indications of the Island Rule? **Mariah C. Schlis-Elias*** and **Jason L. Malaney**, *Austin Peay State University, Clarksville, Tennessee*. Island Rule remains an important, but contested, topic in biogeography. In general,

large-bodied mammals tend to decrease in size while smaller mammals frequently get larger when occupying island systems. Voles (genus *Microtus*) are one system hypothesized to experience island effects, so this project aims to expand upon past research by comparing morphological variation of island and mainland voles using 18 craniodontal measurements. Principal Component Analysis shows that skull variation overlaps amongst island and mainland populations, but these groups display differences indicative of active divergence. Analysis of variance detects a significant increase in occipitonasal length and significant differences on PC1 between five of the seven islands studied and the mainland. These data and analyses will be broadened to include islands in Southeast Alaska. Morphological analysis will be expanded to analyze size and shape variation in concert with environmental and geographic variables to test if differences are attributable to the Island Rule.

Differences in the number of songbirds flushed in response to calls given by bird eating and non-bird eating hawks at a feeding station in northwest Tennessee. **Randy Z. Gillespie III*** and **H. Dawn Wilkins**, *University of Tennessee at Martin, Martin, Tennessee*. Recognizing potential threats can influence survival of wintering songbirds. Reacting to sounds that are not a threat, wastes time and energy that could be spent foraging. Our goal was to determine if songbirds were more likely to flush upon playback of calls from non-bird eating hawks (non-threat) as compared to calls of bird-eating hawks (threat). Our study site was a feeding station near a permanent blind. We used playback of Red-tailed Hawks (*Buteo jamaicensis*) and Red-shouldered Hawks (*Buteo lineatus*) as a non-threat and Cooper's Hawks (*Accipiter cooperii*) as a threat. The mean number of birds present after playback of Cooper's Hawk calls was significantly less than the number of birds present before playback. There was no difference in the number of birds present before and after playback of Red-tailed Hawk and Red-shouldered Hawk calls, suggesting that songbirds may be distinguishing between the calls of bird eating and non-bird eating hawks.

Tick-transmitted pathogens (*Borrelia* spp. and *Babesia* spp.) detected in blood-fed and questing ticks from the Cumberland Gap region. **Elizabeth L. Maggard*** and **Barbara C. Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. Ticks can transmit a diversity of pathogens that can be harmful or fatal to humans and other animals. The purpose of this research was to determine the diversity of Ixodid ticks, and their associated pathogens in the Cumberland Gap region. The objective of the study was to identify ticks obtained via dragging and opportunistic collection and then screen them for *Babesia* spp. (protozoan parasite) and *Borrelia* spp. (Lyme disease-associated bacteria). Ticks were collected (N = 311) from the Cumberland Gap region, and identified to the species level. DNA was extracted from 178 ticks and PCRs specific to *Babesia* and *Borrelia* spp. were conducted. Positive amplicons from *Borrelia* PCR (26/72) and *Babesia* PCR (24/178) will be identified to the species-

level with Sanger sequencing. These data contribute to our knowledge of Ixodid tick natural history in Appalachia. These data also suggest that potentially zoonotic pathogens are circulating in the Cumberland Gap region.

Mechanosensory sensitivity of naïve hawkmoths. **Benjamin T. Allen* and Joaquín Goyret, The University of Tennessee at Martin, Martin, Tennessee.** *Manduca sexta* are large, nocturnal hawkmoths that feed on nectar by hovering in front of a flower while probing it with their long proboscis. In order to find the nectar, *M. sexta* have two primary probing behaviors that are guided by visual and mechanosensory (tactile) input. One probing behavior, "tapping," appears to be exploratory and primarily occurs when the moth is probing on a flat surface. However, when a moth detects a groove, it will often display a back-and-forth motion where it runs its proboscis along the groove. Taking advantage of this conspicuous behavior, we are using 3D printed disks with grooves of decreasing width as surrogate flowers to determine the spatial sensitivity of the proboscis. Although the results are preliminary, we have noticed that moths often perform the back-and-forth behavior when probing a disk with 0.1 mm grooves, suggesting that they can detect these grooves.

Identity of "*Tylocephalum*" larvae from Gulf of Mexico bivalves. **Derrick Lau* and John Gunderson, Tennessee Technological University, Cookeville, Tennessee.** Small cestode larvae, supposedly species of *Tylocephalum*, are commonly encountered in bivalves and gastropods from the Gulf of Mexico. Adults of the genus occur in rays, particularly cownose rays. In order to determine whether the larvae from bivalves are indeed species of *Tylocephalum*,

cestodes were collected from bivalves and adult rays from the northern Gulf of Mexico. DNA was extracted from all specimens using a QIAamp DNA Micro Kit. rRNA and mitochondrial sequences were amplified from the DNA. They were then compared with each other and with sequences from GenBank. The supposed *Tylocephalum* larvae consisted of six different species, none of which belong to the genus *Tylocephalum*. All grouped with species of *Adelobothrium* and *Cephalobothrium* in phylogenetic trees. Members of these two genera live as adults in the Spotted Eagle Ray, *Aetobatus narinari*.

The use of Shelby Bottoms Greenway and Natural Area trails by mammalian wildlife. **Kerra L. Gaona* and A. Darlene Panvini, Belmont University, Nashville, Tennessee.** Land fragmentation results in patchy habitats that are difficult for non-avian wildlife to maneuver. Greenways can help mitigate this problem by providing connectivity to patches that may contain crucial resources. However, the effective use of patchy environments, like greenways, by wildlife may be greatly influenced by size and spatial connectivity, relative distance to natural resources such as water, and structure of the path (paved or unpaved). An observational study at Shelby Bottoms Greenway and Natural Area in Nashville, Tennessee assessed trail use by mammalian wildlife. Wildlife cameras and sand pits were used for two months to determine mammalian traffic on trails and which type of trail was most commonly used: paved, primitive, and/or located near a water source. Trails that are primitive and near a water source were expected to have more species richness, greater abundance, and higher diversity than trails that were paved and heavily utilized by humans.