

Abstracts of Presentations at the 2016 (126<sup>th</sup>) Annual Meeting of the Tennessee Academy of Science

Austin Peay State University

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## Oral Presentations

## Agriculture

Tony V. Johnston

Career readiness skills for veterinary science students. **Clint Ary, Jason Roberts, Renee Stubblefield and J.E. Mehlhorn, The University of Tennessee at Martin, Martin, Tennessee.** Veterinary medicine programs continue to be widely popular yet very competitive among U.S. college students. Many undergraduates plan to compete for a spot in one of the nation's 30 veterinary medical programs. It is important that students are prepared early in their college tenure to increase their chances for success. A study was conducted among freshman veterinary science students to determine the career readiness of students and the effectiveness of college orientation programs. The results showed that students do see value in the traditional sciences as well as soft skills for their career goals. Faculty are perceived as being important to the mentoring and development of students as they prepare for post graduate programs. The use of experiential teaching techniques are helpful in engaging students with career development.

Determination of the best winter canola variety for Tennessee. **Edmund Tetteh\* and Jason P. de Koff, Tennessee State University, Nashville, Tennessee.** Canola (*Brassica napus* L.) is a cool season crop from the mustard (Brassicaceae) family which contains around 40% oil. Canola has great potential for biodiesel production, as a winter cover crop and an alternative to winter wheat. The meal remaining after oil extraction from canola seed is an important animal feed source which allows on-farm biodiesel production to be economically feasible. The objective of the research was to determine high oil and protein yielding varieties of winter canola for production in Tennessee. Forty varieties of winter canola were grown in 2014-2015 in a randomized complete block design with four replications. Harvested seed was weighed and analyzed by Near Infrared spectroscopy for oil and protein content. Results will be

discussed and the highest-yielding varieties will be recommended to Tennessee farmers.

Raccoons (*Procyon lotor*) as potential vectors for zoonotic disease in Martin, Tennessee. **C. Cain\*, Clint Ary and J. Roberts, The University of Tennessee at Martin, Martin, Tennessee.** Raccoons commonly carry numerous potentially zoonotic parasitic and bacterial pathogens that may be transmitted to felines and humans. There is a large feral cat population on UTM's campus with which students interact regularly. Thus, any zoonotic pathogens that raccoons transmit to the campus feral cat population may place students at risk. The objective of the present study was to determine the extent of parasitism and the prevalence of *Bartonella* spp. in the raccoon population near UTM's campus. Raccoons (n=12) were caught in live traps, sedated, and examined. No raccoons were seropositive for *Bartonella* spp. All raccoons were positive for internal and/or external parasites. It was concluded that raccoons serve as potential vectors of zoonoses, capable of disease transmission to feral cats and thus students.

Effect of low-level laser therapy on canine lick granuloma. **Sarah Anderson\*, Clint Ary, Amanda Waldon, and Erica Carroll, The University of Tennessee at Martin, Martin, Tennessee.** Low-level laser therapy is a common treatment modality in the veterinary field. Laser therapy is proven to accelerate healing, reduce inflammation, and promote tissue regrowth. The objective of this case study was to determine if laser therapy could aid in the healing of a chronic lick granuloma on the dorsal metacarpal region of a geriatric canine previously unresponsive to medical treatments. The dog received four-minute K-Laser™ medical treatments at 480.0 J three times per week for a total of six weeks. The distal width, proximal width, and length of the open wound were measured and recorded with a Vernier caliper once a week. It was concluded low-level laser therapy promoted regrowth of healthy tissue causing a major reduction in the proximal width of the wound.

Unmanned aerial vehicle research at UT Martin. **Patton Webb\***, **Philip Smartt** and **Sandy Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Unmanned Aerial Vehicles (UAVs) are becoming more popular in the United States, especially in the agriculture sector. However the question remains, how do we bridge the gap between the UAV and actionable data? With current commodity prices in a slump, many are unwilling to adopt UAVs as a tool for production due to finances. The initial price tag can deter many, but equipped with a standard UAV and some common knowledge, producers can mitigate risk and save costs. This research shows that timely, inexpensive imagery from a UAV can save producers money. Whether exposing issues or obtaining insight for writing variable rate prescriptions, producers can benefit from incorporating a UAV into their production.

Controlling powdery mildew on flowering dogwood with different fungicides and biorational products. **Md Niamul Kabir\***, **Prabha Liyanapathirana**, **Terri Simmons**, and **Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. Powdery mildew is one of the most important diseases in containerized or field nursery production of flowering dogwood (*Cornus florida* L.). Routine fungicide application is essential for dogwood powdery mildew management. The rising threat of fungicide resistance in plant pathogens and environmental risks of using fungicides in crops are becoming major concerns. Biorational products are highly specific in their activity and also safe to humans and the environment. The objective of this study is to provide efficacy test results for dogwood powdery mildew management. The results indicate that fungicides – Concert II, Pageant, Mural, Cleary's 3336F and biorational products – Regalia, Triact 70, effectively reduced powdery mildew. This study will help nursery producers to make decisions about fungicides and biorational products on their production.

Detection of pharmaceuticals in East Fork Stones River in Rutherford County, Tennessee. **Ravneet Kaur\***, **Anonya Akuley-Amenyenu** and **Sam Dennis**, *Tennessee State University, Nashville, Tennessee*. Recent studies have reported pharmaceutical drugs including steroids, prescription drugs such as antibiotics, anti-depressants, anti-inflammatory drugs, and hormones and over the counter (OTC) drugs in aquatic environments. We conducted a study to detect the presence of pharmaceuticals in Stones River (East fork), Rutherford County. The river drains a large portion of Rutherford County including Murfreesboro, Tennessee. Grab water samples were collected from Stones River for three seasons (summer 2014, fall 2014, and winter 2015). Water quality data were also collected at the same time using Eureka™ multi-parameter Sondes. Water samples were analyzed for the presence of pharmaceutical compounds using GC-MS. Pharmaceuticals detected included those used for treatment of chronic alcoholism, antibiotic drug and anti-inflammatory conditions.

Zoonotic risk: a study of crypto infection rates of cattle in Lincoln County, Tennessee. **Aaron Helms\*** and **Christina Galben**, *Austin Peay State University, Clarksville, Tennessee*. Looking at *Cryptosporidium* infection rates in Lincoln County, Tennessee will give information that shows the areas of higher zoonotic risk. *Cryptosporidium* is a microscopic parasite that is spread through the environment by sporulated oocysts. To be symptomatic, there should be  $10^5$ – $10^7$  oocysts/mL in feces. Tests were performed on 1-2 mL size samples. The oocysts are small, 4-6  $\mu$ m in diameter; testing required a 1 micron filter. We found a 100% infection rate in the fecal and water samples tested, with an average of 20 oocysts/mL in feces and 5 oocysts/L in water. Each result was below what is considered to be symptomatic and with the water we found 5 oocysts/L. This information tells us that the human population of Lincoln County, Tennessee is probably safe from infection.

Single-cell type proteomics for studying stress-induced pollen infertility. **Yingde Zhu\***, **Suping Zhou**, **Hui Li**, **Sarabjit Bhatti**, and **Ted Thannhauser**, *Tennessee State University, Nashville, Tennessee and Agricultural Research Service, United States Department of Agriculture, Ithaca, New York*. Continuous exposure of tomato 'Money Maker' to high temperatures (38/26°C, 32/26°C) will reduce the number of pollen grains and decrease viability. Anthers will be collected and examined under a microscope for the presence or absence of pollens. The FDA dye test method and the pollen germination test method will be compared. Treated pollens will be under *in vitro* viability test and the results will determine the heat treatments for inducing non-viable pollens or non-germinable pollens. In addition, treated pollens will be tested for pollinating tomato flowers to determine if heat treatment induced *in vivo* nonfunctional pollens.

## Botany

Sunny Fleming

Evaluation of the composition and structure of algae assemblages in response to eutrophication in Tennessee streams. **Molly R. Grimmer\*** and **Jefferson G. Lebkuecher**, *Austin Peay State University, Clarksville, Tennessee*. The effects of stream impairment on fish and macroinvertebrates are well studied and used to quantify eutrophication by bioassessment. The use of algae for bioassessment is far less common and much remains unknown of the community and structural response to eutrophication. In this study, the effects of eutrophication on algae assemblages were analyzed. Eight streams in eight watersheds in Tennessee were sampled. There were two primary goals: (1) to document the diversity of algae taxa found in Tennessee streams; (2) to correlate the composition and structure of the algae assemblages to stream trophic status. A total of 200 taxa were found at the sites sampled. Prior to this study, 99 of the

200 taxa had not been documented in Tennessee. There was a significant ( $p < 0.0001$ ) seasonal difference in composition between May and August. The results demonstrate that the composition and structure of algae assemblages is significantly affected by the trophic state of streams.

Pollination and phenology analysis of the endangered endemic, *Physaria globosa* (Brassicaceae). **Heath Thacker\*** and **Shawn Krosnick**, Tennessee Technological University, Cookeville, Tennessee. Commonly referred to as Short's Bladderpod, *Physaria globosa* was federally listed as endangered in August 2014 throughout its range among Tennessee, Kentucky, and Indiana populations. Historically, 55 known populations of the endemic forb had been observed, however, it is now known to only inhabit 26 sites. By identifying the limiting factors associated with the species, further extirpation may be impeded. This research will highlight the visitation frequency and effectiveness of pollinator species by identification of invertebrate floral visitors, and subsequent assessment of *P. globosa* pollen loads. In concert with this work, an analysis of reproductive phenology will also provide further insight into the little known biology of the species, collectively serving to benefit the determination of best management practices in the future.

New insights into the reproductive biology of *Passiflora incarnata* L. (Passifloraceae) in Middle Tennessee. **Shawn E. Krosnick**, Tennessee Technological University, Cookeville, Tennessee. *Passiflora incarnata* is a flowering vine commonly encountered along roadsides and abandoned fields throughout the southeastern United States. In the present study, clonal individuals in Middle Tennessee were examined for mode and frequency of andromonecy, relationship between fruit set and floral gender, and degree of self-incompatibility. Andromonecy was observed in all individuals; clones exhibited five distinct morphs ranging from fully hermaphroditic to aborted. Type 3 (erect, spreading styles) and 4 (styles level with anthers) morphs were observed in greatest frequency within and across clones. The amount of nectar and overall floral size correlated with floral morphs. Bees visited hermaphroditic flowers for greater lengths of time than male flowers. The presence of male flowers was positively associated with the presence of mature fruit on the vine. It is likely the presence of the five morphs is due to abortion of flowers at various stages of development in response to fruit development.

Germination of exotic versus native winter annuals in response to changes in moisture and temperature. **Rachael N. Hicks\***, **Fenglan Wang**, **Siti N. Hidayati**, and **Jeffrey L. Walck**, Middle Tennessee State University, Murfreesboro, Tennessee. Winter annuals are an important component of anthropogenic and natural ecosystems. We investigated the effects of climate change (increased rainfall and summer and night-time temperatures) on after-ripening (dormancy loss) over a 15-100% relative humidity gradient at 25 and 30°C

and germination at 20/10 and 20/15°C. Winter annuals studied included the exotics *Buglossoides arvensis*, *Lamium purpureum*, and *Ranunculus parviflorus* and the natives *Galium aparine*, *Paysonia stonensis*, and *Plantago virginica*. We found: (1) responses to increased moisture during after-ripening were unimodal or linearly increased or decreased, (2) increased temperature lowered the moisture threshold for after-ripening and viability (75% at 25°C, 50% at 30°C), (3) increased night-time temperature nulled *Ranunculus* germination but did not affect other species, and (4) highest germination was 33-39% for *Paysonia* and *Plantago* but 56-95% for other species. Thus, climate change may differentially influence germination among winter annuals with the clearest disparity being less germination for natives (except *Galium*) than exotics.

A survey of the vascular flora of Cedar Hill Wildlife Management Area, Robertson County, Tennessee. **John Shelton\*** and **Dwayne Estes**, Austin Peay State University, Clarksville, Tennessee. Cedar Hill Swamp is a 200-acre wildlife management area managed by the Tennessee Wildlife Resources Agency (TWRA) located in the Pennyroyal Karst Plain ecoregion of Tennessee. It is one of the few remaining remnants of a depressional swamp community in this ecoregion. Until recently, it was also home to one of the few remaining wet prairies in the region as evidenced by the presence of the rare sedge, *Carex buxbaumii*. This small remnant is one of only a few that remains of a once large complex of prairies that dominated much of the Pennyroyal Karst Plain two hundred years ago. For this study, a floristic inventory identifying all vascular plant species was created to document the baseline botanical information for future studies. Additionally, a survey was conducted to identify the plant communities present at Cedar Hill Swamp. These have been qualitatively described and mapped in Google Earth.

### Cell and Molecular Biology

Bonny B. Millimaki

A genetic model system to reveal processes underlying human polyglutamine diseases. **Elise A. Kikis**, **Amy Lee\***, **Fridien Tchoukoua\***, and **Hailey Ung\***, The University of the South, Sewanee, Tennessee. Huntington's Disease (HD) is an age-related neurodegenerative disease with symptoms including spasmodic movement and dementia that first appear in mid-late life. HD is one of nine distinct progressive neurodegenerative disorders that are caused by polyglutamine expansions in certain proteins. The neurodegeneration associated with all of the polyglutamine disorders is caused by the aggregation and resultant toxicity of the disease-associated protein. To determine which genes and proteins regulate protein folding, aggregation, and toxicity, we use the genetically tractable model system *C. elegans*. These animals have been engineered to express the disease-associated proteins huntingtin and ataxin-3. We have

demonstrated both the versatility of *C. elegans* as a model system to study human disease, and the fact that different polyglutamine-containing proteins have different aggregation dynamics, thereby indicating that the protein context in which a polyglutamine tract is embedded significantly affects aggregation and toxicity in a manner that may be relevant to disease.

Expression and characterization of immune function genes and toll-like receptors (TLR) in the adult Guinea fowl using transcriptome analysis. **Gabriel Akerele\***, **Samuel Nahashon and Thyneice Taylor**, *Tennessee State University, Nashville, Tennessee*. The aim of this research was to develop molecular tools to support immune function research in Guinea fowl (*Numidea meleagris*). Thirty-six guinea fowl divided into 2 groups of 3 replicates each (6 birds/replicate) were raised from 0-6 weeks of age on standard poultry diets. The treatment group was immunized with heat-killed *Salmonella Typhimurium* and Complete Freund's adjuvant, while the control group was mock-challenged. A booster dose was given after 21 days. After 24-48 hours, RNA was extracted by phenol-chloroform (Trizol® reagent) from the pancreas, liver, intestine muscle, spleen, bone marrow, bursa and thymus. High quality RNA (RIN  $\geq 7.5$ ) was used for library construction (300 paired-end) and sequencing on Illumina HiSeq 4000 platform. The *De novo* assembled contigs served as template for differential gene expression. The qPCR was carried out to determine expression of TLR 15 in the bursa, spleen, and bone-marrow. TLRs were expressed in a wide range of tissues.

Growth and metabolic indices of furazolidone-induced cardiomyopathy in the pearl grey Guinea fowl. **Collins Khwatenge\***, **Samuel Nahashon and Thyneice Taylor**, *Tennessee State University, Nashville, Tennessee*. Physiological changes associated with induced Dilated Cardiomyopathy (DCM) in guinea fowl were elucidated. Three replications of five-week old Pearl grey guinea fowl keets were fed corn-soy diets containing 0 (control), 400, 600 and 800 parts per million (ppm) Furazolidone for four weeks. Total RNA was extracted from liver and heart tissues, reverse transcribed and quantified to evaluate the expression of the cardiac and liver Troponin (TNT) and Phospholamban (PLN) genes. Feeding guinea fowl 800 and 600 ppm Furazolidone successfully induced cardiomyopathy in Guinea fowl. The induction of DCM was associated with a significant decrease in feed consumption, body weight gain and feed efficiency. Feed containing 600 and 800 ppm Furazolidone had a significant down regulation of TNT and PLN in the heart muscle and liver. Liver hyperplasia, severe ascites, a decrease in serum creatinine, bilirubin, glucose, protein, and alkaline phosphatase, and an increase in serum glutamic pyruvate transaminase were also observed.

Investigating olfactory hyper-sensitivity in fragile X syndrome mice. **Priscilla O. Ajilore\***, *Drexel College of Medicine, Philadelphia, Pennsylvania, and Lee University,*

*Cleveland, Tennessee*. This research focused on the cause of increased sensory responses in the rodent model of Fragile X Syndrome (FXS) disease. Previous research has shown that FXS mice exhibit elevated baseline odor responses. This raises a number of questions: Is there an increased number of Olfactory Sensory Neurons (OSNs) in the knock-out mice? Is there a broadening of OSN response profiles? Or, is each OSN responding at an elevated level? The Olfactory Marker Protein (OMP) was used as a readout for the presence of OSNs and phospho-S6 Ribosomal Protein (pS6) as a readout of activated OSNs in the mice after odor exposure. The study of the OSN activation patterns in these mice revealed that the knock-out mice showed a doubled level of OSN activation compared to the wild type mice. This led to the conclusion that the olfactory hypersensitivity observed in FXS mice could be a result of broadened OSN response profiles.

### Chemistry

Sarah Pierce

The preparation and reactivity of novel ferrocene complexes via several common organic condensation reactions. **Ma-kayla Brashears\***, **Stephen Everly**, **Cassandra Jones\***, **Hannah Oakes\***, and **Emily Thompson\***, *Lincoln Memorial University, Harrogate, Tennessee*. The addition of ferrocene, acetylferrocene, and formylferrocene to suitable organic compounds resulted in the synthesis of novel and interesting complexes. Four different synthetic methods were used. The first method reacted either acetylferrocene or formylferrocene with a sulfa drug to form the Schiff base condensation product. These compounds were tested for their antibiotic activity against several bacterial strains. The second method involved the azo coupling reaction of an aromatic amine to either ferrocene or acetylferrocene to form an azo type dye. The third method followed the Wittig process to couple acetylferrocene with a benzyltriphenylphosphonium salt. The last method used the classical aldol reaction to couple acetylferrocene with two different aromatic aldehydes. The last three methods produced compounds that compared favorably to azo dyes in terms of absorptivity and color fastness.

The quantification of formaldehyde produced from E-cigarettes by different E-juices. **Krista Gardner\*** and **Sarah S. Pierce**, *Cumberland University, Lebanon, Tennessee*. With the usage of electronic cigarettes (e-cigs) on the rise, there is concern for the possible production of carbonyl compounds, which can be toxic, due to the decomposition of the e-juices. The most common nicotine solvents used in e-juices, glycerol and propylene glycol, have both been found to decompose into carcinogenic compounds, such as formaldehyde and acetaldehyde. The aim of this research is to determine if different e-juices produce formaldehyde and to determine the amount of formaldehyde produced. The amount of formal-

dehyde was quantitated using the Hantzsch reaction, a colorimetric method that involves the addition of acetylacetone and ammonium salt to solutions containing formaldehyde. A yellow color is produced due to the formation of diacetyldihydrolutidine (DDL), which is indicative of the presence of formaldehyde in the solution. The formaldehyde content of the solution was determined by ultraviolet-visible (UV-VIS) spectrometry.

The synthesis and antimicrobial activity of potential beta-lactamase inhibitors in combination with antibiotics. **Joshua A. Herring\***, **Ashleigh L. Prince**, **Alexandra D. Slagle\***, **Kadie R. Soall\***, and **Tiffany N. Thoms\***, *Lincoln Memorial University, Harrogate, Tennessee*. Antimicrobial resistance has become an alarming problem worldwide. One major cause of this resistance is the emergence of beta-lactamase enzymes. Several scaffolds are currently being investigated in the primary literature for activity as beta-lactamase inhibitors, including triazoles and chalcones. Both of these scaffolds have previously demonstrated a wide range of interesting biological activities and also exhibit a straightforward synthesis. Numerous triazoles were synthesized and assayed for their antimicrobial activity against several laboratory and clinical strains of bacteria in combination with levofloxacin. Next, chalcone derivatives were synthesized and assayed for their antimicrobial activity against several bacterial strains in combination with penicillin antibiotics. As expected, the triazoles and chalcones displayed no antimicrobial activity on their own; however, both classes of molecules did demonstrate synergistic effects when assayed in the presence of an antibiotic against certain bacterial strains.

Atmospheric spectroscopy: comparison of FTIR and cavity-ring down spectroscopic techniques in trace-greenhouse gas monitoring. **Samuel Hines\***, **Lahiru Gamage\*** and **Wilson Gichuhi**, *Tennessee Technological University, Cookeville, Tennessee*. The Fourier Transform Infrared Spectrometry (FTIR) technique has been used as a method for obtaining IR spectra of greenhouse gases such as carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). While FTIR can be extremely useful, it fails to monitor trace concentrations of gaseous samples that have very weak absorptions in the parts per billion levels. In such scenarios, the use of highly sensitive, optical spectroscopic techniques like Cavity Ring Down Spectroscopy (CRDS) becomes the technique of choice. CRDS provides the capability of measuring trace greenhouse gases at low concentrations by utilizing wavelength scanning technology in the weak, second overtone region of CH<sub>4</sub> and CO<sub>2</sub> gases. We present results of CO<sub>2</sub> and CH<sub>4</sub> measurements using both the FTIR and CRDS techniques to show how the two techniques can be utilized to obtain rich information on the atmospheric spectroscopy of these gases both in the convention IR region and in the second overtone regions.

Green synthesis of Dilantin. **Veronica C. Sublett\*** and **Daniel J. Swartling**, *Tennessee Technological University, Cookeville,*

*Tennessee*. The purpose of this research is to use the Principles of Green Chemistry to develop a safer and more efficient pathway to produce Dilantin (5,5'-diphenylimidazolidine-2,4-dione), a pharmaceutical drug that is used in the prevention and control of grand mal seizures and complex partial seizures. The synthesis of Dilantin is made up of three separate steps. The first step of the synthesis is the production of benzoin. Almond extract, a sustainable material, replaces benzaldehyde as the starting material. The second step of the synthesis is the oxidation of benzoin to benzil. Different oxidation methods were studied in order to optimize a less hazardous route to benzil as well as to reduce the amount of waste. The last step of the synthesis is the production of Dilantin from benzil. The final step incorporates the use of solar energy in order to increase the energy efficiency.

### Ecology and Environmental Science

Jeronimo Gomes Da Silva Neto

Contributions to ecology of the globally-rare Hall's Bulrush [*Schoenoplectiella hallii* (A.Gray) Lye, Cyperaceae]. **Edward W. Chester**, *Austin Peay State University, Clarksville, Tennessee*. Hall's Bulrush is an obligate wetland, summer annual known from a few sites in 10 states. Known populations south of the Ohio and east of the Mississippi River are in Christian and Logan Counties, Kentucky, where six populations have been found. Sites are depressions within upland agricultural fields that are often flooded during winter-spring. Receding water during late spring-summer exposes a silt-loam substrate that is available for plant colonization. Occasionally, complete drying early in the growing season allows for agricultural tillage and the species then exists as a persistent seed bank. Germination occurs in shallow water and, in addition to flooding, requires light and ethylene from decaying vegetation. The documented flora of the dewatered zone of the six sites includes 36 species, but only six of these, *Ammannia coccinea*, *Echinodorus tenellus*, *Eleocharis obtusa*, *Leucospora multifida*, *Lindernia dubia* and *Rotala ramosior* are considered ecological associates. The remaining 29 are mostly agronomic weeds.

Effects of mining on aquatic macroinvertebrate communities in surface mined streams of the Cumberland Mountains in East Tennessee. **Gordon A. Counts\*** and **Joseph R. Schiller**, *Austin Peay State University, Clarksville, Tennessee*. Bioassessment of the macroinvertebrate communities of three tributaries of Smokey Creek in the southern Cumberland Mountains of eastern Tennessee was performed to assess recovery from surface mining. Assessments using the Tennessee Department of Environment and Conservation (TDEC) Multimetric Macroinvertebrate Index (MMI) of these three tributaries were compared to those of a reference stream to evaluate their relative impairments. These assessments are preliminary findings of a larger bioassessment

study of eight more streams, with varying intensities of mining impact, that have been studied intermittently for almost 40 years. The goal of this more comprehensive study is to analyze the long-term recovery from mining disturbance for streams in this ecoregion. Our results, when compared with previous bioassessments of these streams, will provide understanding of the long-term impacts of local mining to streams and the effectiveness of coal mine reclamation in the southeastern Appalachian Mountains.

Monitoring agriculturally impacted ponds using aquatic macroinvertebrates in West Tennessee: a ten-year study. **Lauren K. Schnorr\* and Steven Hamilton, Austin Peay State University, Clarksville, Tennessee.** A ten-year study was conducted at the Milan Army Ammunition Plant in Milan, Tennessee to compare aquatic macroinvertebrates in five agriculturally impacted ponds and five ponds that were non-impacted. The macroinvertebrates were collected by deploying funnel traps in the ponds once a year in late spring/early summer for two consecutive 48-hour periods from 2006–2015. Community assemblages were compared using indices such as diversity, evenness, and similarity to measure the degree of impairment in the ponds. The diversity of agriculturally impacted ponds is significantly higher than the diversity on non-impacted ( $F=0.0013$ ) whereas there are no significant differences in evenness ( $F=0.1113$ ).

Depressed, wet, and in the woods: macroinvertebrate community variation in temporary woodland pools. **Brandy N. Schnettler\*, Steven W. Hamilton and Joseph R. Schiller, Austin Peay State University, Clarksville, Tennessee.** Temporary woodland pools are common in the Pennyroyal Plain north of Clarksville, Tennessee. The objective was to identify correlations between aquatic macroinvertebrate community structure in these wetlands and measures of landscape disturbance. We used canopy density, canopy height, and vegetative buffer as disturbance metrics. Mean maximum water level was measured as an estimate of hydroperiod. Macroinvertebrates were collected from ten sites using funnel traps and substrate sampling. Identified specimens were grouped as active or passive dispersers. Significant associations were indicated between disperser ability and site that is best explained by habitat variation in maximum water level and vegetative buffer. Our findings suggest that well-buffered sites are more ephemeral, likely a result of reduced runoff. The most ephemeral study sites have the most unique communities compared to each other and all other sites. Disturbance may have major impacts on temporary woodland pools, including increased permanence and decreased biodiversity.

Bioaccumulation of mercury in spotted bass from Norris Reservoir, Tennessee. **Aggy Vanderpool, Damon Johnson and Brian Evanshen, Lincoln Memorial University, Harrogate, Tennessee and East Tennessee State University, Johnson City, Tennessee.** From April to August of 2015, 24 spotted bass, *Micropterus punctulatus*, ranging from 171 mm to 394 mm in

total length were collected by hook and line from a mercury consumption advisory area and from outside of the consumption advisory area on Norris Reservoir. The purpose of this study is to determine if total mercury levels in fillets of spotted bass differed between fish from the advisory area and the non-advisory area in Norris Reservoir. The study objectives include an examination of total mercury levels in spotted bass fillets relative to age and size of the fish collected. Total mercury analysis is being conducted by ICP-MS. Results for mercury analysis will be reported in ppm. Mercury concentrations in spotted bass collected from the advisory area and non-advisory area for Norris Reservoir will be compared by a non-equal paired t-test at an  $\alpha = 0.05$ .

Impacts of forest management on small mammal communities in pine-hardwood forests of Alabama. **Brent C. Newman\* and William B. Sutton, Tennessee State University, Nashville, Tennessee.** Landscape disturbances in the form of forest management strategies can cause significant changes to habitat and microclimatic conditions, however, the extent that disturbances impact wildlife is poorly known. From May to August 2016, we live-trapped and tick-dragged six different silviculture treatment stands replicated three times across the landscape to assess species diversity, richness, and abundance of small mammal and tick communities following forest management activities at Bankhead National Forest in northwestern Alabama. The white-footed mouse *Peromyscus leucopus* was the most abundant species captured during trapping, followed by the golden mouse *Ochrotomys nuttalli*, and cotton deermouse *Peromyscus gossypinus*, respectively. Collection of habitat data is ongoing, but will be included in future analyses to assist in the evaluation of mammal responses to forest management strategies. Tick specimens collected will also be identified and analyzed via quantitative PCR to elucidate patterns of tick-borne disease in northwestern Alabama.

Use of remote sensing data to model above-ground woody biomass in Tennessee. **Man K. Giri\* and Bharat Pokharel, Tennessee State University, Nashville, Tennessee.** Mapping spatial distribution of woody biomass is the prerequisite for a continuous supply of feedstock for biofuel production. Field-based forest inventory is costly and time consuming; thus, remote sensing (RS) images could be important variables while mapping the biomass. The main objective of this study is to identify important predictors derived from RS data while mapping biomass at operational scale. Landsat 5 TM, 2007-2011 images were acquired and processed. Different variables such as vegetation indices, national land cover data, tree canopy cover, and digital elevation model were used. Data were extracted by pairing Forest Inventory and Analysis plot data from 2007 to 2011 with spatially referenced layers. A nonparametric approach, the Random Forests was used to build a predictive model. The model explained 46.87% of variability with RMSE of 17.14 dry tons acre<sup>-1</sup>. Map modeling method was used to

generate a continuous gridded biomass map across the state of Tennessee.

Microhabitat selection by the Eastern Hellbender salamander (*Cryptobranchus alleganiensis alleganiensis*) in Tennessee. **Jerônimo Gomes Da Silva Neto\*** and **William B. Sutton**, Tennessee State University, Nashville, Tennessee. The Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) is a fully-aquatic salamander that inhabits cool, well-oxygenated streams and rivers in the eastern United States. Although once abundant, *C. a. alleganiensis* populations have experienced major declines across the historical range due to habitat degradation, aquatic contaminants, and infectious diseases. Several studies have explored habitat selection of *C. a. alleganiensis*, but few have evaluated microhabitat requirements for this species. We evaluated microhabitat use of larvae, juvenile, and adult *C. a. alleganiensis* at three sites in eastern Tennessee by comparing microsites occupied by *C. alleganiensis* to random sites within the stream. We used discriminant function analysis to evaluate microhabitat use differences among life stages and between occupied and random locations. The collective goal of this project is to identify microhabitat characteristics that are important for long-term *C. a. alleganiensis* conservation, and to better understand how sedimentation and habitat degradation can impact *C. a. alleganiensis* populations.

#### Engineering and Engineering Technology

John Byrd

DC motor speed control via a centralized control system over a Profibus network. **Parker Wyatt\***, **William Sunderland\***, **Blake Johnson\***, **Omar Tantawi**, and **Khalid H. Tantawi**, Motlow State Community College, Smyrna, Tennessee. In this work we present a toolbox of ladder logic functions that are used for speed control of a DC motor. The motor speed control function is loaded on a field programmable logic controller (PLC), while control of the field devices is performed from a master PLC that is connected via the Siemens Profibus network to the field PLCs, in a centralized control system. Speed control of the field motor is achieved by a potentiometer that is connected to the analog input of the master PLC. Data is then transferred to the field PLCs, which in turn provide the required field control of the motor. The toolbox can be integrated with the previously developed Motor Controls Toolbox to provide a wide collection of motor control functionalities within a low-cost centralized supervisory motor control system.

A low-cost metal detector with wireless transmission. **Yasmin Musa\*** and **Khalid H. Tantawi**, Motlow State Community College, Smyrna, Tennessee. A device that consists of a metal detector with a capability to transfer data in a low power wireless form is presented here. The device consists of an inductive sensor that is connected to a wireless transmitter

that is based on the Marconi transmitter. Upon detection of a metal by the inductive sensor, the transmitter sends the data to a Programmable Logic Controller that is connected to the receiver circuit, which in turn uses the detected signal for processing.

Recent advances in friction stir welding for in-space manufacturing. **Russ Longhurst** and **Allyn Smith**, Austin Peay State University, Clarksville, Tennessee. Friction stir welding (FSW) is a solid state material joining process that has been identified by NASA as a preferred joining method for lightweight metals with low melting points. However, the current state-of-the-art limits FSW to Earth-bound operations due to the large process forces which require robust machines and the labor intensive quality control methods. Recent work has been directed toward the development of a portable FSW machine for use in space and an in-process quality monitoring system. The key enabler of the portable FSW machine is a floating bobbin tool that is self-adjusting and aligning (SAA). The SAA tool is able to keep the large process force for forging internal to the tool, while floating along the surface to self-adjust and align with the workpiece. For the in-process monitoring, a clamp-on current meter and examination of the frequency content of the welding torque serve as the key enablers.

Additive manufacturing, innovation and techno-entrepreneurship ecosystem in the Upper Cumberland Region. **Ismail Fidan**, Tennessee Technological University, Cookeville, Tennessee. Tennessee Technological University has a number active R&D and Workforce Development projects in Advanced Manufacturing, Innovation and Techno-Entrepreneurship. Most are externally funded from National Science Foundation and Internal Sources. This presentation will provide short debriefs about the current ATE, I-Corps Site, REU Site, QEP, and CISE Projects. Sample student projects will also be presented.

#### Geology and Geography

Michael W. Bradley

Water depth and distance from shoreline for the Coon Creek Formation (Western Tennessee) in the Late Cretaceous Eastern Mississippi Embayment portion of the Cretaceous Interior Seaway. **Michael A. Gibson**, The University of Tennessee at Martin, Martin, Tennessee. The Coon Creek Formation (Late Cretaceous) is a marine shelf lagerstätten deposit well known for its abundance of fossils preserved nearly unaltered or compacted. The Coon Creek's depth and distance from shoreline, components of local paleogeography, have not been constrained. Existing depth/distance features include (1) paleobathymetric constraints of the preserved fauna (e.g., algal and sea grass occurrence, ammonite paleobathymetry, corals) (2) geochemical markers (e.g., oxidation states, carbonate nodules), and (3) sedimen-

tological indicators (e.g., ichnofossils, glauconite and phosphate occurrence, sedimentary structures). The Coon Creek was probably below normal storm wave base, but less than 50 meters in maximum depth. Proximity to shoreline is more problematic to discern. However, surrounding lithofacies, presence of land-derived geochemical signature (e.g., C isotope signature) in some fauna, and exotic terrestrial fossil components (e.g., "bloat and float" dinosaurs, wood, amber) suggest a not too distant shoreline, perhaps only a few 10's of kilometers away at best.

Groundwater hydrology in a karst aquifer at Tennessee State University. **Renas Barzanji\***, **Lonnie Sharpe** and **Tom Byl**, *Tennessee State University, Nashville, Tennessee (RB, LS) and U.S. Geological Survey, Nashville, Tennessee (TB)*. Karst refers to carbonate bedrock with fractures, caves, sinkholes and a complex hydrology. The objective of this project was to characterize the hydro-geology of the groundwater aquifer at Tennessee State University (TSU) research farm in Nashville. There are 9 wells drilled into bedrock (depth ranging from 175 to 250 feet below ground surface). The direction of groundwater flow was calculated using the triangulation method and water level measurements. The transmissivity and storage capacity of the bedrock aquifer were also evaluated in an aquifer pump test ( $T = 317$  sq ft / day;  $S = 0.0002$  to  $0.0003$  gal/cubic ft). During the same aquifer pump test, measurements were taken and found that the cone-of-depression radiating from the pumping well extended approximately 350 meters from the pumping well. The groundwater flow direction varied over the study period. The flow went to the west-southwest or north-northwest.

Attenuating acid-rock drainage by stimulating sulfur-reducing bacteria. **Tom Byl** and **Michael Bradley**, *U.S. Geological Survey, Nashville, Tennessee*. Middle and East Tennessee pyrite-bearing formations are exposed during road construction, leading to acid-rock drainage (ARD). As the pyrite ( $FeS_2$ ) is exposed to oxygen, water and sulfur-oxidizing bacteria, it decomposes, forming sulfuric acid from sulfur oxides. The objective of this research was to reverse the sulfur-oxidation process by stimulating sulfur-reducing bacteria. The scope of the research included use of flow-through microcosms in the laboratory. Several supplements expected to stimulate anaerobic, sulfur-reducing bacteria or raise the pH were evaluated, including NaOH, NaOCl,  $K_2HPO_4$ , sodium lactate and soy infant-formula. When no supplements were added (control microcosm), the pH of the microcosm discharge waters remained acidic (pH 2-3.5,  $Fe^{2+}_{aq} > 40$  mg/L). The supplement mix of NaOH followed by soy infant-formula and sodium lactate holds promise (pH 6.2,  $Fe^{2+}_{aq} < 10$  mg/L) by reversing the bio-geochemical processes responsible for acid production.

A statistical interpretation of the pear-shape of the Earth. **A. Tan**, **A. Alomari\*** and **M. Schamschula**, *Alabama A & M University, Normal, Alabama*. The orbital analyses of

artificial satellites have revealed that the averaged meridional section of the Earth was 'pear-shaped.' Various attempts to explain this pear-shape based on physical principles have proved to be inconclusive. In this study, a new approach based upon statistical correlation between variables has been advocated. It is shown that the average land-water distribution bears significant correlation with the geoid heights. Specifically, the distribution of water is directly correlated to the geoid heights whereas the distribution of land is inversely correlated with the latter. This analysis is consistent with the principle of mass loading and is also able to locate the 'stem' of the pear at the North pole. It is suggested that the correlation between land-water distribution and the pear-shape of the Earth is causal rather than coincidental.

### Health and Medical Sciences

D. Nicholas Ragsdale

A veterinarian's perspective: experiential learning by undergraduate pre-veterinary students. **Christina W. Galben**, *Austin Peay State University, Clarksville, Tennessee*. Undergraduate pre-veterinary students may lack the expected veterinary guided experience, critical thinking and problem solving skills when ready to apply to veterinary schools. I have developed a course that actively involves students in experiential learning activities, while also serving as veterinary guided experience for the student. Examples of experiential learning I discuss include activities that involve research, design conceptualization and construction, experimentation, diagnostic procedures, and technical skill training, all of which may lead to a transformative learning experience, as well. As a veterinarian not formally trained in academia, I have found experiential learning to be a cogent method to unite traditional lecture style teaching with the acquisition of deductive reasoning and problem solving skills.

### History of Science

Brother Kevin Ryan, Martin V. Stewart

The making of the atomic bomb. **Brother Kevin Ryan**, *Christian Brothers University, Memphis, Tennessee*. Between 1939 and 1945, the USA made three atomic bombs; all three successfully went off in about a three-week period.

Proclus' commentary on the first book of Euclid's Elements. **John J. Schommer**, *The University of Tennessee at Martin, Martin, Tennessee*. A university student in a modern upper-division geometry class can expect to see a development of defined and undefined terms, axioms, theorems, and very little philosophy. This was not the case for students studying geometry in fifth century Athens. A student of Proclus would spend almost as much time studying platonic and neo-platonic philosophy as he/she would Euclid's geometry. In

this talk we will examine the philosophical/historical features of Proclus' commentary on Euclid.

Archibald Belcher's work experiences in Fort Worth, Texas (1906-1907). **Martin V. Stewart**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Archibald Belcher (1870-1924) was one of the original 18 faculty when Middle Tennessee State Normal School opened in 1911. A biography of Archibald Belcher is being written. Following graduate work in classical philology at Harvard University (A.M., 1895-1897), Belcher spent ten years as a high school teacher, first in Colorado at Leadville High School (1897-1901) and later in Texas at Houston (1901-1906) and Fort Worth (1906-1907) High Schools. Although his stay in Fort Worth was brief, his work there played a pivotal role in converting this classics scholar into a physical science professor and helped to prepare him for his subsequent employment as a science professor in Normal Schools in Oklahoma and Tennessee.

#### Mathematics and Computer Science

David R. Grimmett

Block Numerov-type numerical method for fractional variation of van der Pol equation. **Paul M. Watkins\*** and **Samuel N. Jator**, *Austin Peay State University, Clarksville, Tennessee*. We numerically evaluate a fractional variation of the van der Pol equation using a Numerov-type method. Numerov's method excludes first derivatives, but a block of equations is constructed such that the derivative values are approximated along with the function values. We evaluate error with comparison to other methods.

Conservation of African elephants. **Travis Collard\***, **Jessica Elliott\*** and **Alison Flowers\***, *Austin Peay State University, Clarksville, Tennessee*. For centuries, elephants have played a crucial role in the progress of human civilization. However, demand for ivory has led to the excessive killing of elephants worldwide, which has resulted in elephants being added to the endangered species list. We plan to analyze the population of African elephants in particular and create a stage-matrix model to help us identify causes for this population decline, aside from illegal poaching for ivory. We will examine specific regions of Africa to see which regions are having success in the conservation and regrowth of their elephant population in hopes to isolate factors that may contribute to this success. Upon isolating these factors, we hope to suggest how these factors can be extended to other regions of Africa so that the African elephant population can be restored and removed from the endangered species list.

Defining the cycle space associated to orbits of semi-simple lie groups. **Ben Ntatin**, *Austin Peay State University, Clarksville, Tennessee*. Lie groups acting on manifolds

normally give rise to induced actions on the parameter spaces of certain geometric objects related to the manifolds in question. These in turn give rise to new representations on associated spaces of functions. In this talk we give a definition of the parameter spaces of certain nonlinear geometric objects (cycles) in the natural setting of group action of real forms of semi-simple Lie groups acting on flag manifolds. We will only consider low-dimensional examples.

Developing a new block method to solve Schrödinger's equation using mixed basis functions. **Kaitlyn J. McCollum\*** and **Samuel N. Jator**, *Austin Peay State University, Clarksville, Tennessee*. Schrödinger's equation, the defining equation of quantum mechanical motion, permeates throughout mathematics, physics, and chemistry as one of the most difficult equations to solve. Having the ability to analyze Schrödinger's equation accurately and efficiently could lead to important discoveries on the subatomic level, especially in the research on wave-particle duality. In this study, a Numerov-type block method was developed in *Mathematica* using a mixed cardinal sine basis to increase the accuracy and efficiency of the Numerov method for wave-functions with singularities and series solutions, as in Schrödinger's equation. Implementing the method with the isothermal gas sphere equation affirms that the new method is more accurate for functions with singularities and series solutions, decreasing errors by as much as five orders of magnitude. The new block method can be used in the numerical integration of Schrödinger's equation with accuracy, an important step for further research on solving Schrödinger's equation.

Fractional calculus and its applications. **Kindyl L. King\*** and **Samuel N. Jator**, *Austin Peay State University, Clarksville, Tennessee*. We present a brief history of fractional calculus and its current applications across multiple disciplines of science. Fractional calculus, introduced by Leibniz and L'Hopital in 1695, deals with non-integer orders of differentiation. The Riemann-Liouville and Caputo definitions of fractional differentiation support theoretical methods in making certain models more precise. Fractional calculus has been effective in studying areas of physics such as rheology and viscoelasticity. These viscoelastic applications translate heavily into biology and material science. Fractional models can describe polymers, epidemics, biological tissue mechanics, and neural systems more accurately. Since most of the research in this area of mathematics is relatively recent, more applications are still possible and have not yet been discovered. Moreover, several fractional models are very complex and do not possess closed form solutions, hence our future research will be devoted to developing numerical solutions for such models.

High Plains aquifer model. **Ramanjit K. Sahi**, **Jonathan Collins\***, **Micah Folk\***, **Jesse Guy\***, and **Patricia Iman-Hill\***, *Austin Peay State University, Clarksville Tennessee*. There is a massive aquifer in the high plains in the central United

States of America that is losing water at an alarming rate. The High Plains water system is vast and dynamic, and there is a multitude of data from a variety of sources that we will narrow down and use for our mathematical model. We will use discrete dynamical systems and probabilistic systems to simulate water flow in and out of the aquifer. As there are many different discharges and recharges of water volume, there can be many solutions to the problem of water stability and sustainability. We will be searching for a reasonable way to reduce the risk of water depletion in the High Plains aquifer.

Linearization and solution approximations for nonlinear differential equations. **Allison B. Hardee\* and Daniel Biles, Belmont University, Nashville, Tennessee.** Many nonlinear ordinary differential equations do not have an easily discoverable explicit solution. In order to learn more about these equations and their solution functions, we can use linearization and assorted approximation methods, such as the Runge-Kutta numerical approximation and the Taylor series approximation, as guides to the nature of these solutions. By comparing these methods, we can achieve a greater understanding of how the solution acts. In this talk, we will address a variety of nonlinearities and discuss the measures taken to better understand their solutions.

Mapping the unmapped of Nigeria. **Oluwatito P. Ebiwonjumi\* and William Hooper, Belmont University, Nashville, Tennessee.** Despite the apparent global reach of GPS, many areas of Nigeria remain poorly mapped. We propose a system using mobile phones to create more accurate maps of these remote regions. The system will consist of: a database collecting location data from phones, an algorithm to infer safe routes, and a mobile app to upload data and download routes. Development of this system will help us understand how computer science is used in cartography. It also allows us to explore new ways to create data from public input.

Problems in algebraic combinatorics. **Tucker L. Dowell\* and Brad Schleben, Belmont University, Nashville, Tennessee.** The group of all permutations on  $n$  elements,  $S_n$ , has myriad applications. The better we understand the structure of  $S_n$ , the more versatile our use of  $S_n$  when we use it to understand something in the world. The number of elements that square to the identity in  $S_n$  is determined by a well-known recursion. We study a generalization of this question: for which values of  $k$  are there exactly  $k$  elements such that  $x^k$  is the identity? Given any  $n$ , we determine the greatest  $k < n!$  and the least  $k > 1$  that satisfy this condition.

Using topological invariants to prove selected calculus theorems. **Brent Champion\*, Paul M. Watkins\* and Ben Ntatin, Austin Peay State University, Clarksville, Tennessee.** We present some basic ideas from topology, namely compactness and connectedness. We use these concepts of topological invariants to prove the Extreme Value Theorem and the Intermediate Value Theorem. These theorems are

useful in applications across various fields, but in calculus courses the proofs are usually omitted.

Variations of network attitudinal models. **Emily Stark\* and Mark Orr, Austin Peay State University, Clarksville, Tennessee (ES) and Virginia Polytechnic Institute and State University, Blacksburg, Virginia (MO).** Network theory is ubiquitous with applications ranging from physics to political science, but it can also be used to explain how we view the world. Social psychologists and cognitive psychologists agree on the merit of a network representation of an attitude state, but arrive at many possible algorithms and models due to assumptions about how information is processed. Therefore, it is crucial to understand the statistical methods from which these models are derived. This study explores three popular approaches within cognitive psychology (the Causal Attitude Network Model, Neural Network Computation, and the Schema Model) using data from the 1984 American National Election Survey to discuss the differences in data processing and structural assumptions.

Vector representations of musical harmonic structures. **Brandon Stephens and Peter Eigel, Belmont University, Nashville, Tennessee.** The existing field of musical set theory provides numeric representations of fundamental musical elements such as pitches and pitch classes. Our research is directed at creating an algebraic model of musical harmony that is suitable for automation. We began by extending the simple numeric representations in musical set theory to group structures. We then created vector representations of more complex musical structures. Using linear operations on these vectors, we created a model that predicts the root and tonality of a chord defined by arbitrary pitches. With this information, we were able to ascribe harmonic roles to the transition between every pair of chords. We hypothesize that a model based on these harmonic roles could predict the keys of chord progressions defined by arbitrary chords. In the future, we hope these models could be extended to include iterative feedback, furthering their automation potential and accuracy.

### Microbiology

Chris Barton

Impact of coaggregation in biofilm formation of early dental plaque streptococci. **Anika Ahmed\*, Ashley Frantellizzi\*, Steven P. Tammariello, and Giancarlo A. Cuadra, Lincoln Memorial University, Harrogate, Tennessee (AA, GC) and Binghamton University, Binghamton, New York (AF, ST).** Coaggregation is the phenomena by which various bacterial species adhere to each other and seems to be an integral component of biofilm formation. Coaggregation molecules on *Streptococcus gordonii*, SspA/B and CshA/B, allow cell-cell interactions with various oral species, including *Strep-*

*Staphylococcus oralis*. In this study, *sspA/B* and *cshA/B* genes are knocked out to test bacterial biofilm formation. Results show growth kinetics in batch cultures and autoinducer-2 activity are not affected in coaggregation mutants. Furthermore, coaggregation between *S. oralis* and *S. gordonii* is diminished when *CshA/B* is knocked out, signifying *CshA/B* is essential for the interaction between these two commensals. The inability to coaggregate in biofilm co-cultures affects *S. oralis* growth. Our results show that regardless of autoinducer-2 availability, coaggregation is vital for certain commensal species during early dental plaque formation. Thus, this study highlights the importance of coaggregation for bacterial survival in oral biofilms.

### Physics and Astronomy

J. Allyn Smith

Modeling chalcogenide glasses and thin films using the cation-interlinking network cluster approach (CINCA) with post-Hartree-Fock Methods. **Justin Oelgoetz and Laura Judy\***, *Austin Peay State University, Clarksville, Tennessee*. Typically large extended networks can only be modeled with classical approximations (such as molecular mechanics methods) or semi-empirical methods (such as PM6). In some cases very large density functional theory calculations are possible. The Cation-Interlinking Network Cluster Approach (CINCA) approach to modeling glassy or amorphous networks treats the network as interconnected Network Forming Clusters (NFCs). As the NFCs considered in CINCA are much smaller than the whole network, calculations on these NFCs can be done using more computationally expensive methods. This work presents recent results using post-Hartree-Fock methods to model NFCs in Chalcogenide glasses and thin films. While it is not yet clear if the results from post-Hartree-Fock methods are significantly better than those derived from Density Functional Theory, we do show the methodology is useful for simply explaining many properties in these materials.

Initial results of annealed carbon films from paste deposition. **Kevin W. Cooper and Alicia Jessie\***, *Lincoln Memorial University, Harrogate, Tennessee*. Carbon films have the desirable potential ability to exhibit tunable mechanical and electronic properties between the extremes exhibited by graphite and diamond. The deposition of these films poses several challenges in their fabrication, including their expense. A paste deposition method was explored in consideration of the dual goals of decreasing the cost of fabrication and the ability to create films with a large surface area. The films were fabricated utilizing a graphite precursor material and an ionic liquid additive. A set of films were deposited via paste method and subsequently post-processed by annealing at ambient atmospheric conditions. Initial measurements consisting of compositional characterization

through EDX and electronic characterization from standard current-voltage relations will be presented.

Zinc oxide nanowire scintillator for ultrafast gamma-ray detection. **Daniel C. Mayo, Claire E. Marvinney\*, Richard R. Mu, and Richard F. Haglund Jr.**, *Austin Peay State University, Clarksville, Tennessee (DM); Fisk University, Nashville, Tennessee (RM); and Vanderbilt University, Nashville, Tennessee (CM, RH)*. A new type of gamma-ray scintillator is urgently needed to improve the resolution of positron emission tomography (PET) scan images that are used for cancer diagnoses. Current scintillators have a slow response time, which translates into a high spatial uncertainty and yields images with poorly defined boundaries. Conversely, ZnO nanowires have a response time that is an order of magnitude faster with an analogous improvement in spatial resolution. Moreover, initial experiments show ZnO nanowires are radiation hardened with highly transient lattice defects. To optimize overall scintillator efficiency, the emission can be enhanced through a combination of optical-cavity effects and plasmon-exciton coupling while the low interaction volume of the nanowires can be addressed by adding a high-Z backing layer to attenuate incoming gamma rays. The ability to decouple emission efficiency and gamma-ray interaction provides a unique materials workbench and establishes ZnO nanowires as a highly promising PET scan scintillator material.

Citizen science with NASA/MSFC, the U.S. Space and Rocket Center, and Austin Peay State University for the 2017 eclipse. **Mitzi Adams, Dennis Gallagher, Ghee Fry, J. Allyn Smith, and Spencer Buckner**, *NASA-MSFC, Huntsville, AL (MA, DG, GF) and Austin Peay State University, Clarksville, Tennessee (JAS, SB)*. Scientists from Marshall Space Flight Center in Huntsville, Alabama are partnering with the U.S. Space and Rocket Center and Austin Peay State University to promote and carry out citizen science during the August 21, 2017 total solar eclipse. Approximately 100 extended-stay space campers, ages 15-17, will spend the week before the eclipse learning about the Sun, eclipses in general, radio astronomy, and ionospheric propagation of radio waves. Students will carry out experiments before, during, and after the eclipse, resulting in data that can be used by ionospheric scientists to learn more about Earth's ionosphere. The students' data will be uploaded to several websites such as <http://reversebeacon.net>, <http://radiojove.gsfc.nasa.gov/>, and <http://theinspireproject.org/>.

Repeat of the Eddington experiment for the 2017 total solar eclipse. **Spencer L. Buckner**, *Austin Peay State University, Clarksville Tennessee*. During the May 1919 total eclipse Sir Arthur attempted to verify the predictions of Einstein's General Relativity by observing the apparent shift in location of stars near the Sun. The experiment was hailed a success despite the fact that the observed shifts barely exceeded the experimental uncertainties. The total eclipse of August 21, 2017 presents an opportunity to repeat the

Eddington Experiment using modern equipment. Calculations by Bradley Schaefer of LSU show that a single image taken with modern equipment can achieve an accuracy of 1%. If multiple images from multiple locations are combined the uncertainties can drop to as low as 0.019%. APSU plans on being part of a group of astronomers along the eclipse path using similar equipment to repeat the Eddington Experiment. Details of the experiment and expected results will be discussed during this presentation.

Examination of variability in BD+17°4708. **Jesse McGaha\***, **J. Allyn Smith and Douglas Tucker**, *Austin Peay State University, Clarksville, Tennessee (JM, JAS) and Fermi National Accelerator Lab, Batavia, Illinois (DT)*. The Sloan Digital Sky Survey (SDSS) was a five-color imaging survey of the northern galactic hemisphere, completed in 2005. The magnitude zeropoints for each filter of the survey were tied to the star BD+17°4708, a metal poor F-class star. Recently, Bohlin & Landolt, (2015) announced this star is a variable. We present data from an intensive search of the SDSS archives to examine this variability, and its implications for the status of the SDSS results.

A new cataclysmic variable: WDC\_0234-455. **Jamin E. Welch\***, **Mees B. Fix**, **J. Allyn Smith**, **Douglas Tucker**, and **William Wester**, *Austin Peay State University, Clarksville, Tennessee (JW, JAS); Space Telescope Science Institute (MBF); and Fermi National Accelerator Lab, Batavia, Illinois (DLT, WW)*. In an effort to develop new calibration sources to support the Dark Energy Survey, we have been observing white dwarf stars. As part of this effort, we discovered a new cataclysmic variable (CV). CVs are important for study as they are one of the probable supernova Ia progenitors. We have obtained preliminary spectroscopy and photometry for this system. We present the light curve data, highlighting period, discuss current theories regarding CV type, and discuss future efforts for the continued study of this system.

New insights on the open cluster Dolidze-35. **J. Allyn Smith**, **Jacob Robertson\***, **Deborah Gullede\***, and **Douglas Tucker**, *Austin Peay State University, Clarksville, Tennessee (JAS, JR, DG) and Fermi National Accelerator Lab, Batavia, Illinois (DT)*. Dolidze-35 is recently confirmed open star cluster which we have been studying for the past four years. We present a review of the literature and new photometry of the cluster looking specifically at potentially new members of the system and present plans for a spectroscopic campaign to determine metallicity of the cluster.

### Science and Mathematics Teaching

Weston Dulaney

modules at Middle Tennessee State University. **Mark J. Abolins**, **Judith Iriarte-Gross** and **Lisa Langenbach**, *Middle Tennessee State University, Murfreesboro, Tennessee*. During 2015–2016, Abolins, Iriarte-Gross, and Langenbach implemented education modules developed by the National Science Foundation (NSF) Interdisciplinary Teaching about Earth for a Sustainable Future (InTeGrate) project. One prominent outcome was the addition of service learning to an introductory Earth Science course in conjunction with the InTeGrate “Environmental Justice and Freshwater Resources” module. A second prominent outcome involved the use of the InTeGrate “Map Your Hazards” module in an Honors Physical Science course. This led to 2 of the 17 Physical Science students submitting an abstract for consideration in connection with the 2016 Tennessee Academy of Sciences Annual Meeting. A third prominent outcome was the use of the InTeGrate “Humans’ Dependence on Earth’s Mineral Resources” module in Langenbach’s American Public Policy course. Use of the module in her course constituted the first use of a two-week natural science module in a non-geography MTSU social science course.

How studying globular clusters can bridge the divide between experts and novices in astronomy. **Christopher McDonald\*** and **Jo Lynn Tyner\***, *Austin Peay State University, Clarksville, Tennessee*. In astronomy there is a steep learning curve that is compounded by the vast difference in the knowledge of experts and students. We worked toward an effective way to learn and teach methods of determining metallicity and radial velocity dispersion of globular clusters to level that curve. These methods allow us to determine the rate of evaporation, mass, and members of a globular cluster or galaxy. We picked globular clusters M5 and M13 due to the vast amount of established data to verify our findings. By working on simpler techniques we were able to effectively learn the tools of the trade such as TopCat, IRAF, and LabView. We were able to establish easy to follow instructions for future students to follow to minimize the steep learning curve associated with these techniques and to be able to answer questions that experts in the field take for granted.

Exploring the impact of an arboretum curriculum designed for undergraduate biology students. **Patrick E. Phoebus\***, **Michael Rutledge** and **Kim Cleary Sadler**, *Middle Tennessee State University, Murfreesboro, Tennessee*. This study’s purpose was to explore the impact of an interactive online arboretum guide on the ecological knowledge, environmental attitudes and beliefs, and environmental behaviors of undergraduate biology students. Students in comparison classes engaged with the arboretum curriculum, while the arboretum curriculum was not employed in the control class. Pre- and post- survey data were collected in all classes, while data from student observations, reflections and interviews were also collected from comparison classes. Although preliminary analysis indicates significant differences between pre- and post- scores on ecological knowledge for both groups, no significant differences were found between the

Implementing “interdisciplinary teaching about Earth for a sustainable future” (InTeGrate) undergraduate education

control and comparison groups for this variable. Additionally, no significant differences were found between pre- and post-scores for environmental attitudes and beliefs or for environmental behaviors. Pending analysis, findings that emerge from observational data, student reflections, and interviews will be used to support an enhanced understanding of the impact of the arboretum curriculum.

A novel method of commercial antacid tablet analysis for the introductory chemistry lab. **Stephen C. Everly and Ashleigh Prince**, *Lincoln Memorial University, Harrogate, Tennessee*. Introductory chemistry students often struggle with both stoichiometry and connecting chemical principles to real world applications. A novel method for antacid tablet analysis was developed to allow students to accurately analyze commercial antacid tablets without any background in stoichiometry, gas laws or acid-base chemistry. Students reacted known amounts of calcium carbonate with an excess of dilute hydrochloric acid and collected the carbon dioxide gas via water displacement. The volume of carbon dioxide gas was plotted against the weight of the calcium carbonate samples and a calibration graph prepared. A commercial antacid tablet was then reacted and the volume of carbon dioxide gas evolved was also measured. Students used the calibration plot to determine the calcium carbonate content of the commercial tablet. Overall the method proved to be an accurate, inexpensive and fun way for beginning students to analyze a real commercial product.

Inquiry-based learning for math education majors in a number theory class. **Nick Kirby**, *Austin Peay State University, Clarksville, Tennessee*. Inquiry-based learning puts the process of problem solving by the student at the forefront. In the mathematical context this typically involves some version of the Moore method, in which statements of theorems and basic mathematical definitions are provided to the students, and they are asked to independently produce proofs of the theorems. After teaching number theory at Austin Peay, which is primarily taken by future high school mathematics teachers using an inquiry-based learning style, we consider the subjective experiences of the professor and the students. Mistakes, challenges, and inspirational outcomes of this approach will be discussed.

Connecting with our students: traditional approaches and radical ideas. **Jennifer T. Thomas**, *Belmont University, Nashville, Tennessee*. Providing and facilitating the content of our disciplines to our students is an obvious goal as college educators. However, the ability to connect with our students, to serve as their mentors, and to ignite a passion for learning in them is, arguably, equally important, especially if one acknowledges that teaching and learning are more effective when working with engaged and committed participants. Inspired by numerous books on the science of teaching and learning, as well as books about the millennial generation, I have instituted practices and policies to better connect with my students in an effort to improve their

learning and performance in class. I will describe traditional approaches such as mandatory meetings with first-year students outside of class, as well as more radical methods such as weekly walks and a no email policy. I will share the outcomes of these approaches which suggest improved student connection and performance.

DNA barcoding as a research and teaching tool in the undergraduate curriculum. **Darlene Panvini and Chris Barton**, *Belmont University, Nashville, Tennessee*. DNA barcoding can be used to explore a variety of scientific questions and is more frequently being implemented for taxonomic identification. Requiring fairly simple procedures and moderate expenses, DNA barcoding seems like a good option to introduce undergraduate students to molecular techniques. We implemented DNA barcoding into an undergraduate research project to identify plant species on a green roof as part of a larger project examining green roof diversity. Students involved in the research helped develop protocols to be used in a botany course as part of a tree identification project. The pros and cons of using DNA barcoding in undergraduate research and courses and as a taxonomic tool will be discussed. While there are limitations, applications of DNA barcoding can enhance undergraduate research and courses.

#### Zoology Juliann Waits

Differential utilization of arboreal and ground level habitat by the North American deermouse (*Peromyscus maniculatus*). **Kelsi Palmer\***, **Nathanael Prather** and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. During the summer of 2015, multiple locations at three different elevations were sampled in the Cherokee National Forest in eastern Tennessee to assess differential habitat utilization by the North American deermouse (*Peromyscus maniculatus*). Sampling was conducted at ground and arboreal levels. Sherman live traps were placed on the ground and on platforms in the vegetation. Capture rates for ground and arboreal levels ranged from 1.2% to 11.7% and 1.1% to 17.5%, respectively. Statistical analyses were conducted to assess differences in occurrence (capture rates) of animals between and among elevational gradients. Results reflected no statistical differences within elevations, but there was a statistical difference in captures among the elevations. The study provides new insight relating to habitat utilization by *Peromyscus maniculatus*.

A comparison of biodiversity measures of small mammals at arboreal and ground levels in edge habitat of eastern deciduous forest. **Sarah E. Swing\*** and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. Biodiversity measures (species richness, species evenness, species abundance distribution, and biodiversity) of small mammals were investigated in edge habitat in eastern deciduous forests

during 2015. Assessments were in forest-field edge habitats (shrub layer = arboreal; forest floor = ground level) associated with the Edward J. Meeman Biological Station located in Shelby County, Tennessee. The prediction that there was no difference in habitat utilization by small mammals in arboreal and ground-level habitats was examined utilizing live-trapping procedures. Results, based on 3,000 trap nights (trap night = 1 trap set for 1 night), 57 captures at the arboreal level, and 91 captures at the ground level, indicated that only species abundance distributions varied significantly between the two habitats. The white-footed deermouse (*Peromyscus leucopus*) and the cotton deermouse (*Peromyscus gossypinus*) were the most common species captured. Such results add to our understanding of habitat use by small mammals in eastern deciduous forests.

I'm not your steppin' stone: recent winter finds and current distribution of the streamside salamander, *Ambystoma barbouri*, in Tennessee. **David I. Withers, Sunny A. Fleming and Stephanie A. Williams**, Division of Natural Areas and Tennessee State Parks, Tennessee Department of Environment and Conservation, Nashville, Tennessee. An environmental consultant's 2015 find of a juvenile *Ambystoma barbouri* from Nolensville, TN, inspired researchers to redouble efforts to find new populations in under-surveyed portions of middle Tennessee. Surveys produced 2 new county records, 2 previously undocumented drainages, 7 additional stream systems, and 13 newly identified breeding populations. The streamside salamander, listed by the TWRA as in "Need of Management," is believed extant from 32 locations and extirpated from at least one historic site. Though ostensibly protected by public lands in two counties, it remains a conservation concern in the rapidly urbanizing lands in and around Nashville. Many new populations have been documented only in response to development permit review or related water quality investigations. As a winter breeder, this species historically is overlooked by field surveys conducted outside of the breeding season, and easily is missed by winter surveys if not specifically targeted.

Interspecific association of ticks on small mammals in Western Tennessee. **Rebecca A. Butler\*, Rebecca Trout-Fryxell, Allan E. Houston, and Michael L. Kennedy**, The University of Memphis, Memphis, Tennessee (RB, MLK); The University of Tennessee, Knoxville, Tennessee (RTF); and The Ames Plantation, Grand Junction, Tennessee (AEH). Interspecific association of tick species (*Ixodes scapularis* and *Dermacentor variabilis*) was assessed on two small-mammal hosts (North American deermouse, *Peromyscus maniculatus* and white-footed mouse, *P. leucopus*). Additionally, the interspecific association of *D. variabilis* and *Amblyomma maculatum* was assessed on the hispid cotton rat (*Sigmodon hispidus*). The study site was the Ames Plantation in Fayette and Hardeman counties in western Tennessee. Animals were captured utilizing Sherman live traps and examined for ticks. A coefficient of association was calculated from a  $2 \times 2$

contingency table for each of the three species of rodents examined. Significance of associations was determined utilizing a Chi-square test. Results indicated a neutral association between combinations of tick species examined. This study adds new insight relating to the interspecific associations of ticks on small mammals.

Sex ratio and fawn-doe ratio for white-tailed deer (*Odocoileus virginianus*) at the Milan Army Ammunition Plant. **Felice A. Murden\*, Steve W. Stephenson and Michael L. Kennedy**, The University of Memphis, Memphis, Tennessee (FAM, MLK) and Milan Army Ammunition Plant, Milan Tennessee (SWS). Sex ratio and fawn-doe ratio were assessed at the Milan Army Ammunition Plant (MAAP) located in Milan, Tennessee, in Gibson and Carroll counties during the summer of 2016. MAAP was approximately 9,080 ha (22,436 acres), which consisted primarily of managed forests, agricultural crops, pasture and early successional fields, open ground, and maintained areas. Assessments were made from roads in a vehicle utilizing a spotlight and thermal-imaging camera. Results of three surveys indicated a sex ratio of 1 male to 2.3 females and a litter size of 0.3 fawns to 1 adult doe. These results are discussed in light of previous studies relating to white-tailed deer.

Ruby-throated hummingbird (*Archilochus colubris*) population growth possibly facilitated by sucrose from feeders. **T. David Pitts**, The University of Tennessee at Martin, Martin, Tennessee. Diets of adult Ruby-throated Hummingbirds (RTHUs) contain approximately 50% sugar (mostly sucrose), which is naturally provided by plant nectar, but in recent years has been increasingly available from feeders provided by humans. Could an increase in the number of feeders have promoted the recent population growth by RTHUs? I used a balance to measure the change in body mass as perched RTHUs consumed 30% sucrose solution. During 106 feeding sessions, RTHUs consumed 0.1 g to 1.0 g (0.08 - 0.83 mL) of sucrose per visit, with a mean of 0.4 g (0.33 mL). Since most flowers provide less than 0.05 mL of nectar per pollinator visit, RTHUs would have to visit numerous flowers to obtain the same amount of sugar they could consume at one visit to a feeder. Reduced feeding time and lower energy expenditure by RTHUs visiting feeders could promote increased lifetime reproductive output and a population increase.

Color preferences in foraging *Manduca sexta*: background color, illumination, and the use of achromatic and chromatic signals. **William Kuenzinger\*, Jonathan Travis\*, Jordan Weesner\*, and Joaquín Goyret**, The University of Tennessee at Martin, Martin, Tennessee. The nocturnal hawkmoth *Manduca sexta* is a nectarous insect pollinator, which as most insect pollinators, relies heavily upon vision and olfaction to evaluate potential feeding sources. It has been shown that *M. sexta* has an innate bias toward dark blue feeders over white ones. Nevertheless, these experiments were performed with a white background, where dark blue offers a strong achromatic contrast. We have performed a

series of experiments in which we manipulate illumination and background color to investigate the visual stimuli naïve moths use during their first foraging bout.

### Poster Presentations Agriculture

Heirloom tomato germination in Tennessee. **Stacy Warwick\***, **S.A. Mehlhorn**, **Phillip Smartt**, and **J.E. Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Tomatoes, *Solanum lycopersicum*, are a high value commodity with significant nutritional value. Heirloom varieties continue to grow in popularity as local food movements continue to grow in the U.S. Today, half of the estimated \$75 million tomato industry in Tennessee is considered a fresh market product. This study compared germination rates of 11 heirloom varieties. Heirloom varieties have the advantage of varied flavors, textures, colors and quality of taste as compared to hybrids. Results found that many of the varieties tested had germination rates above 75%, the acceptable sustainability rate. The data suggest that germination rates found in this experiment coupled with the benefits of the increased biodiversity of crops make heirloom tomatoes a sustainable alternative to hybrid tomatoes for producers.

Diversification, capital structure, and gross sales among farm business households: how does Tennessee compare? **Aditya R. Khanal** and **Suraj Adhikari\***, *Tennessee State University, Nashville, Tennessee*. Agriculture in Tennessee differs in several ways from other regions and states. This analysis compares Tennessee agriculture and farm business households with the rest of the east central mountain region and overall U.S. in terms of economic and financial attributes. Using national level data from Agricultural Resource Management Survey, the study compares the types of farm operations, assets, debt, and equity structure, and gross sales. Results suggest that Tennessee has a larger share of small and part time farmers, have low land acreage per farm but higher net worth and lower debt to asset as compared to rest of the east central mountains. Tennessee needs to prepare the next generation of farmers on how to better leverage farm assets and to exploit economies of scale for efficiency.

Honduran coffee trade: economic effects of fair trade certification on individual producers. **Kevin Herrell\***, **Rachna Tewari** and **Joey Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Global demand for coffee has increased significantly due to emphasis placed on value creation throughout the coffee supply chain, increased consumption in emerging economies, and changes in consumer preference. The specialty coffee industry has highlighted the economic effects on individual participants from producers to consumers. Organizations such as Fair

Trade Coffee have emerged to address producer welfare by encouraging a more equitable income distribution along the supply chain. Historical market data can be used to conduct regression analyses, as well as to build trade models to determine the impact of Fair Trade Certification on producer premiums. This preliminary study will guide future studies to determine the overall impact of Honduran Fair Trade Coffee Certification on producer welfare.

Evolution of online agriculture education: The MSANR case. **Jessica Crews-Garcia** and **J.E. Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Universities continue to look for alternative methods for reaching students that are place bound with academic degree programs. Online degree offerings continue to grow in number and sophistication as delivery systems change. Nationwide, approximately 28% of students take at least one distance education course annually. The requirements for online courses have evolved to become more interactive and build a sense of community and connection with the faculty member and among student participants. Software and hardware issues are discussed along with changes in promotional strategies for attracting and retaining online students. The paradigm changes over the years have allowed faculty more flexibility in developing digital learning objects and provided a more robust learning environment for students. Changes in technology have reduced course development time and the faculty learning curve.

Development of a low-cost protoplast isolation for soybean and canola transformation. **Mary Jane Espina\***, **Korsi Dumenyo**, and **Ali Taheri**, *Tennessee State University, Nashville, Tennessee*. Protoplasts are cells where cell walls are partially or completely removed using enzyme digestion or a mechanical method. With the rising interest in genome editing technologies, the protoplast system is useful for DNA transformation and rapid gene screening. Although the protoplast system is an advanced technology, it is costly as it requires the use of lab-grade enzymes. Here, we aimed to develop a low-cost isolation of protoplasts for soybean and canola using bacterial enzyme extracted from plant pathogens. Results show that 15% and 20% of bacterial enzymes are required to have a comparable protoplast yield to lab-grade enzyme in soybean and canola, respectively. In conclusion, cell wall-degrading enzyme produced by bacteria can be used in isolation of protoplasts and therefore remove the cost barrier in using the protoplast system.

Industrial oilseed production in Tennessee for biodiesel and bio-based products. **Shivam Chawla\***, **Jason P. de Koff** and **Prabodh Illukpitiya**, *Tennessee State University, Nashville, Tennessee*. Bioenergy can be used in place of fossil fuels to enhance environmental sustainability and energy security. The need for low-cost oilseeds suitable for advanced biofuels and bio-based products has stimulated research for new oilseed crops, many of which are cold tolerant. One key objective was to evaluate three winter oilseed crops for

growth characteristics under different planting conditions in Tennessee. Three oilseeds, *Brassica napus* (industrial rape-seed), *Crambe abyssinica* (crambe) and *Brassica carinata* (carinata), were planted on two different dates and four nitrogen application rates (0, 56, 112, 168 kg/ha) in fall 2015 and 2016 in Ashland City, TN. The plants were monitored for plant density/cover, winter injury incidence and photosynthetic activity. Results of differences in plant characteristics and future analyses will be discussed.

Field evolved insect resistance in *Bt* corn inbred variety and non-*Bt* corn inbred varieties to southwestern corn borer (Lepidoptera: Crambidae). **Hebron H. Smith\* and Donald L. Sudbrink**, *Austin Peay State University, Clarksville, Tennessee*. Southwestern corn borer, (*Diatraea grandiosella* Dyar Lepidoptera: Crambidae), is a major insect pest of corn, *Zea mays* L., in the southern United States. Corn germplasm lines with resistance to southwestern corn borer have been developed and released by the USDA-ARS. In this study, one corn inbred variety resistant to southwestern corn borer, one transgenic (Cry1F) corn inbred variety and a susceptible corn inbred variety were field infested with southwestern corn borer larvae in a 3-year field study conducted in Kentucky. The susceptible inbred sustained significantly more leaf damage and stalk tunneling than either resistant inbred. However, only moderate levels of resistance were noted in either resistant inbred. The results indicate that a heterozygous southwestern corn borer population may exist under field conditions causing lower levels of resistance.

Photoperiodism: adaptation of day-length sensitive beans and corn in Tennessee. **Stephen Smith\* and Donald L. Sudbrink**, *Austin Peay State University, Clarksville, Tennessee*. Most common bean and maize varieties are day-light neutral. Un-acclimated, day-light sensitive ones represented as local varieties and landraces have the genetics to allow adaptability to various conditions and resistance to disease and insects that commercial corn and beans don't. Results from this study indicate that greenhouse plantings of these photoperiodic varieties tested could be early initiated and cut the growing season/time by approximately half compared with usual production. The days to tassel for the corn varieties and days to flower for the bean varieties were almost half the typical 170-300 days required for maturity and flower production indicating the initiation of adaptation to local climate. This adaptation is the goal of this project for these corn and bean varieties. If adapted, these corn and beans could prove vital for further research in feeding the growing population as well as for use in future plant breeding operations.

Opportunity and real costs associated with feeder cattle health management: A Pilot Study. **Renee Stubblefield\*, Emalee Buttrey, Jason Roberts, and J.E. Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. Financial costs and growth performance of cattle can be correlated under certain circumstances. In today's tight

margin markets, cattle health is a major concern for producers as they seek to maximize profits through appropriate herd health management protocols. One area that has shown to impact profitability is castration. Castration can be performed in many ways and is considered to be a major stressor for cattle. One factor that can impact cattle performance is the amount of time spent in the chute. Costs associated with castration by an expert can result in higher initial costs but can result in higher net returns when treatment costs are considered. It is essential that producers understand true economic costs associated with management strategies.

Generating high-resolution profiles of histone methylated modification in *Panicum hallii* using ChIP-seq. **Shohana Hug\* and Suping Zhou**, *Tennessee State University, Nashville, Tennessee*. Chromatin immunoprecipitation (ChIP) sequencing is employed to determine the interaction of genomic DNA and proteins in eukaryotic cells. In our study we choose PRMT1 that belongs to the family of methyltransferases (arginine specific) and leads to the formation of an epigenetic transcriptional memory. ChIP-Seq was done by running samples on the Next-Gen Sequencing platform-MiSeq with more than 6-13 million raw reads per samples, which is about 93% mapping ratio to *Panicum hallii* genome (panhal2). The browser track information provides all the peaks identified, roughly 1300 peaks where some of them falls in annotated gene regions which are indeed enriched above the background. Some locations of the *Panicum* genome are also enriched with high protein fold enrichment value which also proves the methylated histone modification in *Panicum hallii*.

Why do Tennessee fruit and vegetable farmers hesitate for organic farming? **Kumuditha D HE Liyanage\*, Hiren Bhavsar, and Md Niamul Kabir**, *Tennessee State University, Nashville, Tennessee*. Demand for organic foods has increased dramatically over the last few years in the USA. However, the number of certified organic farms is very low in Tennessee. The primary objective of the study is to identify and analyze factors affecting the adoption of organic fruit and vegetable farming in Tennessee. Two hundred conventional and organic farmers were randomly selected and pre-approved questionnaires were sent to the farmers via email. Most of the organic farmers have identified high cost of production, labor intensity and certification process as challenges to continue their farming. Conventional farmers have identified lack of knowledge as a major barrier to enter into organic farming. Extension services can help overcome some challenges in improving organic fruit and vegetable production in Tennessee.

Inactivation of food borne pathogens in milk using UV-C irradiation. **Danielle M. Gunter-Ward\*, Ankit Patras, Manreet Singh Bhullar, Agnes Kilanzo-Nthenge, and Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee*. Ultraviolet (UV) light technologies are comparatively more

cost effective and greener than thermal processing (i.e. pasteurization). Our study investigated UV-C light as an alternative disinfection method for milk. *E. coli*, *Salmonella typhimurium*, *Listeria monocytogenes* and two surrogate viruses (MS2, T1UV) were chosen as microbial targets for this investigation. Samples were exposed to a range of UV-C doses at 253.7 nm wavelength. The bacterial and viral targets were inactivated by more than the standard  $5 \log_{10}$  ( $p < 0.05$ ). The results suggested that UV-C irradiation effectively inactivated all microbial and viral targets at commercial relevant UV doses.

Zoonotic risk: a study of crypto infection rates of cattle in Lincoln County, Tennessee. **Aaron Helms\*** and **Christina Galben**, *Austin Peay State University, Clarksville, Tennessee*. Looking at *Cryptosporidium* infection rates in Lincoln County, Tennessee, will give information that shows the areas of higher zoonotic risk. *Cryptosporidium* is a microscopic parasite that is spread through the environment by sporulated oocysts. To be symptomatic, there should be  $10^5$ – $10^7$  oocysts/mL of feces. Tests were performed on 1-2 mL size samples. The oocysts are small, 4-6  $\mu\text{m}$  in diameter; testing required a 1 micron filter. We found a 100% infection rate in the fecal and water samples tested, with an average of 20 oocysts/mL in feces, and 5 oocysts/L in water. Each result was below what is considered to be symptomatic. This information tells us that the human population of Lincoln County, Tennessee is probably safe from infection.

Soil nitrogen and carbon levels in early-planted soybeans versus late-planted soybeans. **Liz Lillge\***, **B. Darroch** and **P.M. Gale**, *The University of Tennessee at Martin, Martin, Tennessee*. Soybean, a legume, is known to contribute nitrogen to the soil as it grows. We were curious as to whether the amount of nitrogen contributed to the soil varied as a function of the soybean variety planted and the date of planting. The experimental design was a randomized field trial. Soil samples were collected from each plot in a staggered manner using a soil probe to a depth of six inches. In the laboratory, soils were analyzed for inorganic nitrogen using a 1 M KCl extract and for soil organic matter by loss on ignition. This poster will illustrate that the differences observed in the growth of the soybeans is also reflected in the soil.

Effects of fungicide timing on soybean yield and yield components. **Kayley Tyner\***, **Kacie Clark\***, **Hailey Holcomb\***, **Hope Renfro\***, and **Barbara Darroch**, *The University of Tennessee at Martin, Martin, Tennessee*. In this study *Viburnum obovatum* plants were inoculated using different inoculation methods and inoculum levels of *Rhizoctonia solani* under greenhouse conditions to determine the disease response. Chopped potato medium, agar slurry and agar plug inoculation methods with three inoculum levels were used. Plant roots were evaluated one month after the inoculation for disease severity using a standardized 1-5

ordinal scale. All inoculum levels of agar slurry method showed significantly higher disease severity compare to the other methods. Agar slurry prepared with 7-days-old *R. solani* cultures can be used as an inoculation method which gives higher disease response in viburnum plants and have the potential to be useful in future research on *Rhizoctonia* root rot disease on other woody ornamentals as well.

Evaluation of inoculation methods and inoculum levels of *Rhizoctonia solani* to determine disease response. **Prabha Liyanapathiranage\***, **Md Niamul Kabir**, **Terri Simmons**, and **Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. This study evaluated the effect of timing of fungicide application on soybeans during the 2015 growing season. Topguard fungicide was applied at a rate of 11 ounces/acre in four treatments: control (no fungicide), sprayed at growth stage R3, sprayed at R5, and sprayed at R3 and R5. When harvested with a large combine, average yield in the R5 treatment was significantly lower than yields in the other treatments. However, there were no significant yield differences among treatments for hand-harvested subsamples. In addition, there was no effect of fungicide treatment on yield components. We concluded that there was no significant benefit to applying fungicide at this location during the 2015 crop year because of the dry conditions later in the growing season.

Aluminum induced proteomics in switchgrass. **Mahesh Rangu\***, **Zhujia Ye**, **Sarabjit Bhatti**, **Suping Zhou** and **Theodore W. Thannhauser**, *Tennessee State University, Nashville, Tennessee, and Cornell University, Ithaca, New York*. Aluminum (Al) stress is a major problem causing reduction in plant growth in acidic soil. Switchgrass (*Panicum virgatum*) plants were grown hydroponically in Al-treated and control cultures. Mass spectrometry with TMT labeling was used to perform proteomic analysis of plant root tissues to document differential protein expression as a function of the Al status. During short-term treatment (<1 month) plants did not show difference phenotypes, but quantitative proteomics analysis of the root-tip and the root elongation zone have identified proteins encoded by Al tolerance genes. Long term Al treatments (> 2 months) also carried out with longer exposure whereby the root structure started to show the typical Al-stress phenotype. Results from the proteomic analysis were used to produce aluminum tolerant plants.

Influence of long-term furosemide use on bone mineral content, bone metabolism markers, and weigh loss in horses. **Abby Pritchard\***, **Holly S. Spooner** and **Rhonda M. Hoffman**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Furosemide is a diuretic commonly used to reduce the incidence of exercise induced pulmonary hemorrhage (EIPH) in racehorses. Previous research suggests furosemide negatively influences calcium balance and may have long-term implications for bone health. In this study, furosemide use was evaluated over 56 days for effect on bone mineral

content (BMC), bone metabolism markers osteocalcin (OC) and pyridinoline cross-links (PYD) and weight loss post administration. No treatment effects were observed for BMC, but there was a period effect across all bone cortices ( $p < 0.0001$ ). OC showed no difference between groups ( $P = 0.26$ ) or days ( $P = 0.25$ ). PYD tended to be lower in FUR ( $P = 0.0584$ ) and exhibited a day effect ( $P < 0.0001$ ). Body weight change indicated day by time ( $P = 0.0001$ ), treatment by time ( $P < 0.0001$ ), and day by treatment ( $P < 0.0001$ ) interactions. While there was no treatment effect on BMC, the trend toward lower PYD in FUR may warrant further investigation with different times and imaging techniques.

Perceptions of welfare regulation at stock-type horse shows. **Andrea R. Rego, Holly S. Spooner and Rhonda M. Hoffman, Middle Tennessee State University, Murfreesboro, Tennessee.** Inhumane treatment at horse shows and member perception of welfare regulation is a sustainability concern of horse show organizations. This study examined beliefs surrounding current self-regulation practices and the impact of professional instruction on awareness of welfare issues. We hypothesized that riders with a trainer would have increased approval of welfare regulations, and association handbooks would be the primary reference regarding ethical practices. An online survey collected demographic information, competition level, and questions regarding current self-regulation and inhumane practices. Eighty-nine percent ( $n = 497$  responses) had over ten years of riding experience. Forty-three percent identified their trainer as the strongest influence regarding ethical practices, while 88% were confident in their trainer as a mentor. A majority agreed current rules and regulations are clearly outlined; 57% disagreed that repeated violators are being appropriately disciplined. Seventy percent of respondents indicated using online sources for welfare news. Further educational programming should focus on education of trainers and online resources.

Effect of different levels of lysine on expression of genes associated with fat accretion in broiler chickens. **Boniface Kimathi\*, Samuel Nahashon and Thyneice Taylor, Tennessee State University, Nashville Tennessee.** The effect of lysine on genes associated with fatness in broiler chickens (BC) was evaluated. Birds were fed diets comprising 1.14% and 1.0% lysine (control) at 0-4 and 5-8 weeks of age (WOA), respectively, as recommended for BC. In the other two diets lysine was either reduced by 25% to 0.855% and 0.75%, or increased by 25% to 1.42% and 1.25% at 0-4 and 5-8 WOA, respectively. After 8 weeks, 4 birds from each treatment group were sacrificed and abdominal fat collected. Total RNA was extracted from adipose tissue using Trizol reagent and quality and concentration determined using the Nano-Drop spectrophotometer. RNA was reverse transcribed to cDNA followed by quantitative PCR amplification using Perilipin, apolipoprotein A1 and adiponectin primers. Expression of adiponectin in adipose tissue of treated birds

was not different from control. However, expression of perilipin was 1.7-fold higher in adipose tissue of birds fed 75% of recommended lysine ( $P < 0.05$ ).

Evaluation of the potential of probiotics to increase phosphorus bioavailability and absorption in broilers. **Joseph Donkor\*, Samuel Nahashon and Thyneice Taylor, Tennessee State University, Nashville Tennessee.** High cost of feed accounts for about 60-70% of production cost. More than 80% of poultry feed is excreted as manure into the environment. Due to inability of the bird to absorb phosphorus, producers add inorganic phosphorus to the diet of the birds at an extra cost. Phosphorus excreted into the environment causes environmental pollution. In the past, *Aspergillus ficus* has been used to increase phosphorus utilization with a beneficial effect on production efficiency. The objective of this study was to evaluate and characterize probiotics that have potential to improve phosphorus utilization in poultry. Microbes selected from chickens were isolated, characterized, repackaged and reintroduced into broilers. A total of three microbes, *Lactobacillus*, *Enterococcus* and *Bifidobacterium* were identified and were used to enhance absorption and utilization of phosphorus in broiler chickens as well as to improve feed intake, body weight gain and feed efficiency.

Cover crop presence and its impact on red maple insect pests. **Sujan Dawadi\*, Karla M. Adesso, Jason B. Oliver, and Paul O'Neal, Tennessee State University, Nashville, Tennessee.** The primary objective of this study is to evaluate flatheaded apple tree borer (FHAB) control in plots with cover crops, but the secondary impact of plantings has been evaluated on other maple pests. Four treatments were evaluated: (1) herbicide + imidacloprid, (2) herbicide only, (3) cover crop + imidacloprid and (4) cover crop only. No ambrosia beetle or spider mite damage was observed in any of the treatments. Maple tip moth (MTM) damage was similar across treatments. Maple leaf tier (MLT) attacked more individual trees in the herbicided plots. Percent damage by plant leafhopper (PLH) ranged from 0.1% to 0.96% and more individual trees were damaged in herbicided plots and in plots not treated with imidacloprid. The imidacloprid, a standard treatment to control FHAB, also has efficacy against PLH. Herbicided plots had more new branch tips and are the likely cause of higher damage by PLH and MLT in those plots.

Patterns in imported fire ant size, geographical distribution, and hydrocarbon/venom alkaloid indices and the potential implications for biological control with phorid flies. **Manoj Pandey\*, Jason B. Oliver and Karla M. Adesso, Tennessee State University, Nashville, Tennessee.** The study purpose was to determine if imported fire ant (IFA) worker ant size is related to IFA species (*Solenopsis invicta* Buren, *Solenopsis richteri* Forel, or *S. invicta* × *S. richteri* hybrid), which may affect successful establishment of biological control agents like *Pseudacteon* phorid-decapitating fly species that have

distinct preferences for worker ant size. The study objectives were to 1) collect IFA worker ant samples throughout Tennessee, 2) to determine IFA species of samples with gas chromatography-mass spectroscopy analysis of venom alkaloid and cuticular hydrocarbon profiles, and 3) to determine IFA worker ant size using head capsule measurements of ant sub-samples from each collection site. The study results indicate IFA species do not differ significantly in worker ant size. Study conclusions are IFA worker ant size will not be a limiting factor in the establishment of different phorid species in Tennessee with varying IFA worker ant size preferences.

### Botany

Stimulation of plant growth by groundwater rich in sulfide. **Danelle Solomon\* and Melanie Kirtland**, Tennessee State University, Nashville, TN (DS), volunteer U.S. Geological Survey, Nashville, TN (MK). Previous research found sterile water artificially enriched in sulfide stimulated plant biomass. This study's objective was to determine if groundwater from Tennessee State University's farm wells, naturally rich in sulfide, stimulated plant growth. Lettuce, radish and oat raised using waters from a well (OW1) containing high sulfide (65-115 mg/L) was compared to one (OW3) with no sulfide. Seeds were germinated in tissue soaked in the experimental waters and raised in a growth chamber at 20°C. The oat plants raised in OW1-water had 3x more lateral roots and 18% greater biomass than plants raised in OW3-water. Lettuce and radish plants raised in OW1 were 35% and 13% larger than those raised in OW3-water, respectively. Cell wall peroxidase activity, microscopic observations and photosynthesis measurements will be presented.

Phylogenetic, SEM, and anatomical analysis of *Viscainoa geniculata*. **J. Mark Porter and Silas C. Maynard\***, Claremont Graduate University, Claremont, California and Tennessee Technological University, Cookeville, Tennessee. Comparatively little research has been performed on *Viscainoa geniculata*, a member of the angiosperm family Zygophyllaceae. The nuclear ribosomal ITS region of *V. geniculata* was sequenced and preliminary analyses shows that the phylogenetic tree is deeply unresolved. These results are not entirely surprising; the family name Zygophyllaceae comes from the evenly pinnately compound leaves, yet *V. geniculata*'s leaves are alternate. Therefore, additional analyses of morphology and anatomy were undertaken to explore the phylogenetic results. Using Sharman's staining protocol, plant tissue of *V. geniculata* was embedded in paraffin and sectioned. SEM analysis of leaf tissue was also performed as a reference for future study of the species. These analyses reveal key characteristics of *V. geniculata* including the production of trichomes and an unknown material in the epidermis of the leaf.

A study of *Croton setiger* Hook and its comparison with other species within genus *Croton*. **Elizabeth B. Jackson**, Tennessee Technological University, Cookeville, Tennessee. This study of *Croton setiger* Hook was performed to examine morphology, anatomy and phylogenetic placement of the plant in comparison to other species within the genus. Leaf tissues were examined with serial sectioning of paraffin embedded tissue and scanning electron microscopy, focusing on the external secretory glands, internal crystals and complex trichomes. DNA was extracted for the assembly of a Bayesian phylogenetic tree. While the gross morphology of *C. setiger* does not resemble other members of the genus *Croton*, there are similarities observed in the glands and trichomes. Phylogenetic analysis strongly supports the placement of this species in *Croton*, suggesting that the morphological differences may be adaptations to the harsh desert conditions to which it is native.

### Cell and Molecular Biology

Intrinsic characteristics of polyglutamine containing htt protein determines proteotoxicity in *C. elegans*. **Hailey Ung\***, The University of the South, Sewanee, Tennessee. Polyglutamine (polyQ) expansions in proteins are the genetic provenances of neurodegenerative diseases including Huntington's Disease (HD). We are interested in delineating the molecular processes of the human huntingtin protein (htt) that result in cellular toxicity. We have characterized the effects of polyglutamine expansion-mediated toxicity in *C. elegans* by expressing the HD-associated human Huntingtin protein (Htt513) in body wall muscle cells. We found that Htt513 aggregates in a polyQ-length dependent manner and that there is a correlation between aggregation and toxicity. Phalloidin staining of actin filaments in the body wall muscle cells disclosed no morphological aberrancies, despite clearly impaired muscle cell function. Immunoblot analysis revealed that the Htt513 transgenic lines express strikingly low levels of Htt513 protein. We conclude that the toxicity associated with the Htt513 protein is caused by its intrinsic characteristics, not protein overexpression. The models introduced here offer tools to expound on the cellular processes underlying polyglutamine-associated toxicity.

Interference of the heat shock response in *C. elegans* through neuronal expression of polyglutamine-expanded ataxin-3 protein. **Fridien Tchoukoua\***, **Hailey Ung and Elise Kikis**, The University of the South, Sewanee, Tennessee. Polyglutamine (polyQ)-expansion in nine different proteins accounts for nine different neurodegenerative diseases. Machado Joseph Disease (MJD), in particular, is caused by a toxic-gain-of-function phenotype associated with a polyQ expansion in the C-terminal domain of the Ataxin-3 protein (AT3). Since *C. elegans* neurons control the organismal heat shock response (HSR), we sought to determine whether the neuronal expression of a polyQ-containing C-terminal fragment of the MJD-associated human ataxin-3 protein (AT3CT)

results in a toxicity capable of hindering the HSR or neuronal cell morphology. Through a DiI-filling assay, we found that expressing AT3CT in neurons did not affect neuronal cell morphology. However, we found that AT3CT expressed in neurons inhibited the HSR in a polyQ-length dependent manner. The data indicate that at least in *C. elegans* the polyQ-expanded fragment of AT3CT disrupts an important transcriptional response to stress.

Identification of novel protein interactions with the transcription factor Six1. **Shannon Strader\***, **Zeynep Gromley** and **Adam Gromley**, *Lincoln Memorial University, Harrogate, Tennessee*. Six1 is a member of the Six family of homeobox proteins whose function is to direct the formation of several different organs during embryogenesis including muscle, kidney, sensory organs, the auditory system, and craniofacial structures. Disruption of this function can give rise to developmental defects such as brachio-oto-renal (BOR) syndrome. In addition to its function in organogenesis, Six1 has also been found to be mutated in a number of human cancers. Although there are numerous studies concerning the genes that are controlled by Six1, there is little information about the mechanisms by which the Six1 transcription factor is itself regulated. To address this, we initiated a yeast two hybrid screen to identify proteins that interact with and, potentially, influence the activity of Six1. Our results have revealed several factors that are known to be involved in transcriptional regulation, as well as some novel Six1 interactions.

Effects of neprilysin expression on stromal and breast cancer cell invasion. **Haley St. John\*** and **Beth Conway**, *Lipscomb University, Nashville, Tennessee*. Neprilysin is an endopeptidase that negatively regulates the pro-invasive endothelin-1 peptide. Its involvement in cancer has been a subject of controversy; studies suggest neprilysin expression correlates with a better prognosis and less metastasis, while others indicate stromal neprilysin expression predicts the opposite. Discerning the role of neprilysin in cancer and stromal cells is vital in understanding its value in diagnosis and treatment of invasive breast cancer. NEP-transfected MDA-MB-231 cells were cocultured with human mammary fibroblasts (MF), and invasion assays were performed to determine the effect on breast cancer cell invasion. Coculturing MDA cells with NEP-expressing MF cells significantly increased invasion 8-fold over MDA cells alone. MDA invasion was significantly decreased in MF cocultures when NEP was overexpressed, compared to normal MDA/MF cocultures. This suggests that neprilysin expression in MDA-MB-231 cells significantly reduces invasion, while neprilysin expression in stromal cells stimulates breast cancer cell invasion without altering stromal cell invasion.

Investigating the effect of super oxide dismutase, 6-hydroxydopamine and exogenous dopamine on the mobility of *Caenorhabditis elegans*. **Arielle Manabat\***, **Abby Rife\*** and **Nick Ragsdale**, *Belmont University, Nashville, Tennessee*.

Parkinson's disease (PD) is the result of dopaminergic degeneration in the substantia nigra of the mesencephalon. Possibly caused by the production of oxygen radicals, PD is characterized by the onset of muscle rigidity, bradykinesia, resting tremor, and postural instability. 6-hydroxydopamine (6-OHDA) promotes the production of reactive oxygen species (ROS). Super oxide dismutase (SOD) eliminates ROS. *Caenorhabditis elegans* (*C. elegans*), a model organism previously employed to examine the pathophysiology of PD, were utilized to investigate both 6-OHDA and SOD in a PD model. In addition, a dopamine (DA) hydrochloride treatment was administered to two groups of wildtype worms to determine if damage induced by 6-OHDA can be ameliorated. Through the use of an S-Basal drop test, the movement behavior and mobility of *C. elegans* were recorded and analyzed. The overall results indicate a difference in movement initiation between treated and untreated nematodes, but also that DA can successfully restore normal mobility.

Seeking behaviors of nicotine on *C. elegans*. **A.J. Arnold** and **Robert Grammer**, *Belmont University, Nashville, Tennessee*. Nicotine is one of the most heavily used addictive drugs in the United States. *Caenorhabditis elegans* is the perfect model organism because of its ability to reproduce rapidly, and it is small and easy to maintain, making it the ideal model to investigate the effects of nicotine. In this experiment, nicotine and *E. coli* will test the seeking behaviors of *C. elegans*. In preliminary results, *C. elegans* were put onto a chemotaxis plate with *E. coli* and 5 mM nicotine on the other end. The nicotine was left on the plate for three hours to diffuse and establish a gradient. Gradually, most of the *C. elegans* started crawling towards the nicotine and only a few toward the *E. coli*. In the future changing the concentration levels of the nicotine and *E. coli* will help better understand the seeking behaviors of the organism.

Disinhibition of *C. elegans* towards *Bacillus thuringiensis*. **Samantha Bush\*** and **Robert Grammer**, *Belmont University, Nashville, Tennessee*. Alcohol has a wide variety of effects on physiology and behavior. One of the most well-recognized behavioral effects is disinhibition, where behaviors that are normally suppressed are displayed following intoxication. *Caenorhabditis elegans* are a model organism because of their ability to reproduce fast, easy to maintain, and similar genome to a humans. In this experiment, *C. elegans* are washed with different dilutions of ethanol. The worms are then put on a chemotaxis plate or in liquid medium to see if the ethanol will cause disinhibition of eating the bacteria *Bacillus thuringiensis*. *Bacillus thuringiensis* will kill the *C. elegans* if ingested.

Insight into the chemotaxis of *Caenorhabditis elegans* toward pathogenic *Bacillus thuringiensis* strain 4A4 using chemosensory deficient nematodes. **Stacey Crockett\*** and **Robert Grammer**, *Belmont University, Nashville, Tennessee*. *Caeno-*

*rhabditis elegans* are model organisms that are widely used in biological research. One of the areas of research involves the understanding of how *C. elegans* react to different types of pathogenic bacteria, such as *Bacillus thuringiensis* strain 4A4 (Bt). Bt is a type of environmentally compatible pesticide, which in its sporulated form, has been shown to be extremely lethal to *C. elegans*. However, it is unclear as to what exactly is attracting *C. elegans* to the bacteria in the first place. One theory is that the bacteria emits specific chemicals that *C. elegans* can detect through specialized cilia and sensory neurons—those that can detect either smell (volatile chemicals) or taste (water soluble chemicals). Preliminary results indicate that *C. elegans* with mutations in their ability to detect volatile chemicals are less attracted to Bt, suggesting that Bt may be secreting volatile chemicals that attract the worms to their death.

Effects on the motor movement of *Caenorhabditis elegans* after treatment with caffeine. **Madeline Johnson\* and Robert Grammer**, Belmont University, Nashville, Tennessee. *Caenorhabditis elegans* is a small nematode that is found worldwide and its sequenced genome, short life span, transparent anatomy, and inexpensive cost make it efficient for experimental purposes. Widely consumed in foods and beverages, caffeine is a psycho-stimulant, meaning it temporarily induces improvements in both mental and physical functions. Recently, a study performed at Belmont University suggested that the concentration of caffeine that *C. elegans* are exposed to, as well as the length of time of exposure, have an effect on the locomotion toward an attractant. Little is known about how caffeine affects the motor movement of *C. elegans*, especially their velocity while chemotaxing. Further work is continuing to investigate the conditions in which caffeine hastens or slows the speed at which the worms propel themselves towards an attractant.

Chemotaxis of *Caenorhabditis elegans* with *Bacillus thuringiensis* 4A4 in vegetative and sporulated growth stages. **Meghan McGath\* and Robert Grammer**, Belmont University, Nashville, Tennessee. A study performed by Angel Brothers at Belmont University looked at the attractant or repellent properties of vegetative *B. thuringiensis* 4A4 and fifth, sixth, and seventh day sporulated *B. thuringiensis* 4A4, a known pathogen of the worms. The study observed attraction to the *C. elegans* during the first hour and significantly reduced attraction by the seventh hour for the vegetative state and the same pattern for first and twenty-fourth hour for the sporulated, pathogenic state. The goal the current study is to find out what occurs to the *C. elegans* during the intervening hours of a chemotaxis assay with vegetative non-pathogenic and sporulated *B. thuringiensis* 4A4. Preliminary results point to the *C. elegans* being attracted to the vegetative *B. thuringiensis* 4A4 and not the control, water. However, more research still needs to be done in order to solidify these findings.

Detection of respiration in *C. elegans* and the effect of different sugars. **Prisha S. Patel\* and Robert Grammer**,

Belmont University, Nashville, Tennessee. Previously, researchers outlined procedures that can be utilized to detect respiration in *C. elegans*, involving the use of spectrophotometry. They also examined worm viability and acidification based on absorbance as well as the effect of sodium azide, a mitochondrial inhibitor. In their experiment, only glucose was utilized to study its effect on acidification by worms. This study will extend the initial study. Fructose, sucrose, maltose, and lactose will be studied in addition to the glucose. It is hypothesized that each sugar will have detectable respiration, but glucose will have the strongest detection. Our worm viability experiments have shown that few nematodes die over a sixty-minute period in the absence of sodium azide. With sodium azide, there are rarely any live worms at each time interval tested. Other experiments are currently underway.

Caffeine's effect on chemotaxis of *C. elegans* at various stages of life. **Emily Shearon\* and Robert Grammer**, Belmont University, Nashville, Tennessee. There is a body of evidence to suggest that the vast majority of nervous system development is complete by the L1 life stage of *C. elegans*. However, nothing has been found that discusses the ability of worms at this stage to perform chemotaxis. Preliminary data from this study show that L1 *C. elegans* have a very poor ability to move towards an attractant. This study is ongoing and aims to see how factors such as chemotaxis time and caffeine exposure affect L1 worms' ability to chemotax when compared to worms at the L4 stage of life. Caffeine is of significant interest in this study due to the large amount known about how the drug affects cognitive and motor skills in *C. elegans* and, more broadly, because it is consumed on a daily basis by so many people worldwide.

Expansion on the nematode scent detection test: evaluating *C. elegans* attraction to non-small cell lung cancer. **Brian R. Song and Robert Grammer**, Belmont University, Nashville, Tennessee. *Caenorhabditis elegans* (*C. elegans*) have been shown to exhibit positive chemotaxis towards the secretions of cancerous cells. By applying this behavior clinically, a cancer screening system has been devised and has shown effectiveness for breast, gastric, and colorectal cancers. Prior research has shown that the nematode is also attracted to cervical cancer, specifically HeLa cells. It has not been assessed whether the screening system would be useful for lung cancer. The objective of this project is to evaluate if *C. elegans* displays attraction to A549 cells, a cell line derived from non-small cell lung cancer, compared to WI38 (normal human lung fibroblast tissue) as a control. It has been observed previously that specific dilutions to the millionth and ten millionth have garnered positive chemotaxis. Our initial results have shown positive and negative chemotaxis as expected regarding these specific dilutions of conditioned A549 medium with fresh medium as the control.

A comparative analysis of microbial profile of chicken and Guinea fowl using metagenomic approach. **Sarayu Bhogju\***, **S. Nahashon** and **X. Wang**, *Tennessee State University, Nashville, Tennessee*. The objective of this study was to characterize microbial profiles of chicken and Guinea fowl (GF) using a metagenomics approach. Amplification of the hypervariable region encoding 9 variable regions of the 16s rRNA genes was used to distinguish gastrointestinal tract (GIT) microbials. Ten chickens and 10 GF raised for 5 months were sacrificed by cervical dislocation and GIT contents collected. A 16s DNA library was constructed and sequencing template prepared using the Ion One Touch-2 system. Template enrichment process was conducted using the Ion One Touch ES system. Enriched samples were amplified, loaded onto 316V2 chip and sequenced using Ion PGM system. Sequencing data were analyzed using Ion reporter software based on Core QIIME pipeline with GreenGenes and Microseq ID databases for phylogenetic diversity. Microbial profiles of chicken and GF revealed taxonomic diversity consisting of almost 150 families and diverse probiotic bacteria indicating that the development or constitution of probiotics should be species specific.

Annotation of the *Acidianus hospitalis* genome by undergraduate students using the GENI-ACT platform. **Steven Wall**, **Katelyn Armstrong**, **Megan Gardner**, **Ariana Whitley**, and **Billy Dye**, *Volunteer State Community College, Gallatin, Tennessee*. Genomic annotation seeks to identify the functions of uncharacterized genes and verify their start and stop codons. Complete genome annotations are crucial for bioinformatics approaches, such as comparing unknown genes to those of other organisms with the goal of determining their function. The organism we have chosen to research is *Acidianus hospitalis*, an archaean with a small genome of 2.13 Mbp. We are investigating genes identified as "hypothetical" due to a lack of expression data and unknown function of the encoded proteins. By utilizing tools like the BLAST search and other bioinformatics analyses through the GENI-ACT platform of the Microbial Genome Annotation Network (MGAN), we are able to quickly find regions of similarity between our unknown gene and identified genes and domains from other organisms. These tools help us to identify the function of our "hypothetical" genes.

Annotation of hypothetical ORFs in the *Acidianus hospitalis* genome. **Braxton Dawson**, **Melissa Ortiz**, **Keri Buttrey**, and **Billy Dye**, *Volunteer State Community College, Gallatin, Tennessee*. With the use of GENI-ACT, an online bioinformatics platform initiated by the Microbial Genome Annotation Network, we examined the genome of an archaean, *Acidianus hospitalis*. We analyzed hypothetical open reading frames (ORFs), with the goal of updating annotations into the genome database. The use of BLAST, a sequence similarity search, gives us information to identify conserved domains and homologous genes in other species. If we suspect that the start codon is in the wrong place, we

use resources at <https://img.jgi.doe.gov/> to search for the alternate start codon. We use TMHMM and PsortB to determine the location of the protein and if it is a transmembrane protein. We find BLAST searches often yield little information as most homologs are also of unknown function. However, searches for conserved domains, predicted transmembrane helices, and other structural motifs often yield results. We have also identified start codon mispredictions, but these seem to be uncommon.

Impacts of Wnt Inhibitory Factor-1 (WIF-1) on the Differentiation of Preadipocytes and Inhibition of Wnt signaling suppresses cancer relapse. **Duaa Babaer\*** and **Xiaofei Wang**, *Tennessee State University, Nashville, Tennessee*. WIF-1 is a secreted protein that inhibits activities of Wnt proteins, known as signaling molecules involved in many aspects of embryonic development. During juvenile development, WIF-1 is expressed in adipose tissue. We hypothesize that WIF-1 regulates pre-adipocyte differentiation and its down-regulation is associated with a variety of cancers. We examined the effect of WIF-1 on differentiation of mouse pre-adipocytes 3T3 cells through the expression of *Igf2*, *Wisp2*, (*C/EBPδ*), and peroxisome proliferator-activated receptor  $\gamma$  (*PPARγ*) which has been implicated as a suppressor in cell types including human breast, lung, and colon cancer. 3T3 cells were treated with 0, 1, 5 and 20 ng/ml of recombinant mouse WIF-1 protein. Total RNA was isolated after 24-48 hours. The levels of *Igf2*, *Wisp2*, *C/EBPδ*, and *PPARγ* mRNA were analyzed with reverse transcription quantitative PCR. Analysis of results will determine whether the recombinant WIF-1 protein can modulate the expression of these genes and regulate cancer.

## Chemistry

Measurement of methane and carbon dioxide concentration levels in ambient air in Cookeville region using cavity-ring-down spectrometric technique. **Lahiru Gamage\*** and **Wilson K. Gichuhi**, *Tennessee Technological University, Cookeville, Tennessee*. Obtaining precise data of trace concentrations of greenhouse gases (GHGs) like methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) has become very important across the whole world. Acquiring such data is the key to gaining critical knowledge on the local, regional and global atmospheric distributions of these gases to aid in understanding greenhouse gas budgets and their trends under a changing climate. In this study, we present results of trace measurements of CO<sub>2</sub>, CO and CH<sub>4</sub> in ambient air the Cookeville region using a Picarro G2401 cavity ring-down spectrometer. By utilizing the wavelength scanning CRDS technology, the instrument is capable of measuring dry mole fractions of CO<sub>2</sub>, CO and CH<sub>4</sub> in ambient air simultaneously at very high precision that goes to ppb level. In a period of one week, CH<sub>4</sub> and CO<sub>2</sub> concentrations of 437 ± 20 ppm and

1900  $\pm$  39 ppb have been recorded within the chemistry department at TTU.

Lycopene in watermelon. **Becca Rae Campbell, Austin Peay State University, Clarksville, Tennessee.** Lycopene is a red carotenoid with a structure including several partial carbon rings and additional hydrogens. During preliminary research, the main standard of lycopene is extracted from tomatoes. It was also found to be less concentrated than the theoretical value found in watermelons. Lycopene is extracted from a watermelon through the Brigg's extraction method. It is then tested for concentration and purity in fractions retrieved by silica column in the ultraviolet spectrum instrument and by electrochemical comparison to a tomato-based standard.

Machine learning 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 critical point descriptors for valence-shell charge concentrations of carbon in a range of aldehydes and ketones has been created. For each critical point, the database contains values of electron density ( $\rho$ ), Laplacian ( $\nabla^2\rho$ ), Hessian eigenvalues ( $\lambda_3, \lambda_2, \lambda_1$ ), as well as radii from the enveloped nucleus. Previous studies indicate that data-mining techniques, used in conjunction with neural networks, can be productively applied in the prediction of properties that would otherwise be expensive and time-consuming to calculate. Predictions are made using Laplacian critical point data, as well as bond critical point data, both separately and combined. The calculated mean absolute percent errors for neural network predictions of C13 shifts, C=O stretching frequency, and interaction energies are 1.19, 0.79, and 16.2 respectively.

Fluorescence assay analyzing the oxidative properties of nicotine. **Dillon Burrow\*, Leslie A. Hiatt and Meagan K. Mann, Austin Peay State University, Clarksville, Tennessee.** Electronic cigarettes (E-cigs) have become a growing topic in media over the past few years. Recently, the FDA set regulations that call for better control of chemical compounds that are added, and for proper labeling of nicotine concentrations. Many chemicals are cleared for food consumption but have not been cleared for inhalation. To better understand the possible risks of E-cigs, a fluorescence assays using 2,7-dichloro-dihydro fluorescein (DCFH) was done to determine the oxidative capabilities of nicotine. Nicotine showed the ability to oxidize DCFH, however, the reaction was pH dependent. More trials need to be done to establish a linear-regression curve using nicotine that will be used to analyze the oxidative properties of E-cig fluid.

Uric acid sensing with multi-walled carbon nanotubes modified with zinc oxide nanoparticles and enzymes. **Robert J. Baltz\* and Charles C. Chusuei, Middle Tennessee State**

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

A simple assay for nicotine: electrochemical characterization of electronic cigarettes. **Allison N. Schmittou\*, Brianna C. Avitabile\*, Leslie A. Hiatt, and Meagan K. Mann, Austin Peay State University, Clarksville, Tennessee.** Due to the rising popularity, the Food and Drug Administration has stated they will begin regulating the manufacturing of electronic cigarettes. The Food and Drug Administration will require all manufacturers to submit samples of their products to be tested. As there is currently no simple assay to quantify the concentration of nicotine and other components within electronic cigarettes, this research is investigating how to meet this demand electrochemically. Our results indicate that nicotine can be studied using an activated glassy carbon electrode, but selectivity is not high enough for quantitation within the complex matrix of an electronic cigarette solution. To increase selectivity and sensitivity, electrodes will be modified to detect interactions of nicotine with tertiary amine reactive compounds. This interaction can also be examined using colorimetric methods. These methods will be used to quantify the amount of nicotine within an electronic cigarette sample compared to a standard of nicotine.

Quantification of nicotine concentration in electronic cigarettes. **Jacob L. Williams\*, Martin E. Miller, Allison N. Schmittou, Leslie A. Hiatt, and Meagan K. Mann, Austin Peay State University, Clarksville, Tennessee.** Electronic cigarettes are gaining popularity across the globe by delivering nicotine as a water-based vapor that is marketed as a smoking cessation aid that is healthier than tobacco products. Until earlier this year, electronic cigarettes were not under the authority of the Food and Drug Administration. Due to the recent lack of regulation, the physiological effects and chemical content of these products has not undergone close analytical scrutiny. Presented here are the efforts towards quantification of nicotine content in electronic cigarette liquids using separatory methods. Using high performance liquid chromatography and gas chromatogra-

phy with a flame ionization detector, nicotine content in several electronic cigarette liquid samples is being assessed to compare listed values to actual nicotine content. Calibration curves are being utilized to determine the amount of nicotine in each sample, variation in batches of the same brand, and degradation of the nicotine in the solutions over time.

### Ecology and Environmental Science

Understory vegetation comparisons between altered and unaltered sites within the low gradient floodplains in MLRA 134. **Amber Gardiner\***, **Lisa M. Krueger** and **Paula M. Gale**, *The University of Tennessee at Martin, Martin, Tennessee*. The modification of major streams and drainage systems in the form of channelization, levee construction and floodplain drainage has the potential to alter many factors that can affect the vegetative composition of forest understories. In order to determine the degree to which site alteration has impacted the environment, we compared environmental and vegetative characteristics from multiple altered and unaltered floodplain sites within MLRA 134. Light measurements and species abundances were measured within twenty 1 × 1 m plots distributed along a 200 m transect at each site. Analyses on species abundance data indicated differences in species richness and diversity across the sites. In addition, several sites differed in overall vegetative composition based on principle component analyses, but whether this difference was due to site alteration is still unclear. Further examination will determine if changes in the floodplain hydrodynamics of these riverine systems has altered soil properties leading to changes in the vegetative community structure.

The effects of fertilizer on decomposition of native and invasive exotic plant species. **Gary W. Noel\*** and **A. Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Human activities introduce potentially harmful chemicals into the natural environment, but the introduction of natural elements, such as nitrogen, may be equally detrimental. This study examined the effects of nitrogenous fertilizer on decomposition of leaves from native and exotic plant species. The effects of canopy cover type were also considered. Leaves of native (*Acer saccharum*) and exotic (*Lonicera maackii*) species were placed in leaf litterbags. Half of the bags included fertilizer, while the other half had only leaves. Bags were weighed and deposited onto the forest floor; one litterbag was removed every three weeks for six months and reweighed to determine mass lost. Both *L. maackii* and *A. saccharum* decomposed more rapidly in the presence of added nitrogen. Additionally, *L. maackii* decomposed quicker than *A. saccharum* overall. These results suggest that the presence of additional nitrogen can exacerbate the role that exotic species have on decomposition and nutrient cycling.

Decomposition rates of *Acer saccharum* and *Lonicera maackii* in mixed litter bags. **Anna Anderson\*** and **A. Darlene**

**Panvini**, *Belmont University Nashville, Tennessee*. Invasion of exotic species can influence decomposition rates and nutrient cycling in a forest. Leaves of exotic species have been shown to decompose faster than native species. This study evaluated decomposition rates of litterbags containing native *Acer saccharum*, exotic *Lonicera macckii*, and both species (mixed species bags). Litterbags were weighed and placed throughout an urban deciduous forest in Nashville, Tennessee at sites that contained canopies of *A. saccharum*, *L. macckii*, or both species. Litterbags were collected over six months and reweighed to determine mass lost. *Acer saccharum*, *L. macckii*, and the mixed species litter decomposed the fastest at the exotic site. The mixed species litter decomposed the fastest at all three sites. The presence of the exotic species increased the rate of decomposition of the native species. The implications of this research will add to the knowledge of changing forests and the effects of exotic species on nutrient cycling.

Conservation genetics of the endangered barrens topminnow. **Alexis Harman\***, **Natalie Ellis\*** and **Carla Hurt**, *Tennessee Technological University, Cookeville, Tennessee*. The Barrens topminnow (*Fundulus julisia*) is one of the most critically endangered fishes of the southeastern United States yet lacks protection from the Endangered Species Act. With only two natural populations remaining, this species is in urgent need of effective management and conservation efforts. In order for these efforts to be successful, they must take into account the dwindling genetic variability of the species. Here we use both mitochondrial sequence data and microsatellites to examine levels of genetic variation and population structure within the remaining natural and introduced populations of this species. Mitochondrial sequence analysis indicates extremely low levels of variation with significant genetic structure between drainages. Microsatellite data shows strong differences in the amount of genetic variation between populations and significant geographic partitioning of genetic variation. These results are interpreted in the context of implications for management and future introduction efforts.

Environmental monitoring of rare freshwater fishes using next-generation sequencing. **Austin L. Ivey\***, **Robert T. R. Paine\*** and **Carla Hurt**, *Tennessee Technological University, Cookeville, Tennessee*. Community composition and true distribution are two important aspects of a species' biology that help management agencies design and implement effective conservation strategies. Environmental DNA (eDNA) combined with next-generation sequencing (NGS) provides a valuable tool for assessing community assemblages in aquatic ecosystems. Here we describe an ongoing study utilizing eDNA and NGS to characterize fish assemblages and detect rare species along the Duck River in Tennessee. We will also develop a molecular index, similar to Integrity of Biotic Indices that are developed using traditional methods. Water samples were collected along a 100 m transect at 12 sites along the Duck River that

consisted of managed and unmanaged areas. Samples were extracted and sequenced on the Illumina MiSeq platform for partial mitochondrial 12S. A reference database was built using sequences from 100+ species to compare against unknown samples. This technology and protocol may offer a valuable tool for improving management design.

Evaluation of madtom diurnal substrate use in the Clinch River, Tennessee. **Sara Kenney\***, **Grady Wells\***, **Jeannette Wolak**, and **Hayden Mattingly**, *Tennessee Technological University, Cookeville, Tennessee*. *Noturus eleutherus* (mountain madtom) is a locally common species found in two Level III ecoregions in Tennessee: Interior Plateau and Ridge Valley. This species' life history and ecology are known; however, little is understood about the mountain madtom's substrate use. Identifying substrate preference may provide insight to another species, the pygmy madtom (*Nothurus stanaulti*), which has been associated with mountain madtoms. In this study, we collected 51 sediment samples by shovel method at nine locations in the Clinch River. Samples were sorted by grain size, ranging from boulder-sized sediment (-8 phi) to silt-sized sediment (5 phi). Frequency histograms were created to identify and statistically compare dominant and sub-dominant sizes among sediment textures at 11 present and 40 absent madtom sites. No significant differences between sediment textures at present and absent sites were identified. Our methods and results will be useful for conservation managers focusing on madtoms and other benthic fishes.

Aquatic turtle biodiversity of an urbanized wetland in Nashville Tennessee. **Brittaney Hogan\***, **Dominique Harris\***, **Nicole Witzel\***, **Jeronimo Silva\***, **Brent Newman\***, **Laura Horton\***, and **William Sutton**, *Tennessee State University, Nashville, Tennessee (BH, DH, NW, JS, BN, and WS)* and *Belmont University, Nashville, Tennessee (LH)*. Biodiversity of organismal communities is often used as an indicator of ecological condition. From April 2016 through September 2016 we surveyed an aquatic turtle community in a ~5 ha palustrine, emergent wetland adjacent to the Tennessee State University agricultural farm. We used large hoop nets baited with either canned fish or dog food to sample turtles. Each captured turtle was weighed, measured, identified to species, and provided an individual-specific mark for later identification. Overall, we captured four species, including the common snapping turtle (*Chelydra serpentina*), stinkpot (*Sternotherus odoratus*), spiny softshell turtle (*Apalone spinifera*), and red-eared slider (*Trachemys scripta elegans*). Numerous recaptures were noted for *T. scripta elegans*, but not for the other three species encountered. Our overall estimates of species richness, evenness, and overall diversity will be compared to other wetlands of similar physiognomy throughout the region to provide an estimate of overall wetland condition.

Occurrence and relative abundance of parasitic leeches (Hirudinea) on aquatic turtles in a wetland environment in

Tennessee. **Laura Horton\***, **Nicole Witzel\***, **Jeronimo Silva\***, **Brittaney Hogan\***, **Dominique Harris**, and **William Sutton**, *Tennessee State University, Nashville, Tennessee (NW, JS, BH, WS)* and *Belmont University, Nashville, Tennessee (LH)*. Aquatic turtles inhabiting a ~5 ha palustrine emergent wetland adjacent to Tennessee State University in Nashville, Tennessee were examined for leeches as a component of a multi-year mark and recapture study. Leeches serve as bioindicators in aquatic environments, and are useful in determining the biological condition of aquatic ecosystems. Aquatic funnel traps were baited and deployed weekly from June to September 2016. Each captured turtle was weighed, measured, sexed, marked, and examined for external leeches. All located leeches were removed and preserved for later identification. Turtle species captured during this study, included the common snapping turtle (*Chelydra serpentina*), stinkpot (*Sternotherus odoratus*), spiny softshell turtle (*Apalone spinifera*), and the red-eared slider (*Trachemys scripta elegans*). The leeches that were collected from the turtles represented four different genera, including *Desserobdella*, *Placobdella*, and *Helobdella*. Collectively, these data can be used to understand parasite-host relationships and how patterns in leech abundance and richness vary seasonally.

Seasonal variations and statistical analysis of the physico-chemical characteristics in a developing wetland in Nashville, Tennessee. **Mark C. Okafor\***, **De'etra Young** and **Thomas D. Byl**, *Tennessee State University, Nashville, Tennessee*. Lands that are seasonally wet over a period of time are referred to as wetlands and they are a vital ecosystem because of the ecosystem services they provide. At a watershed scale level, wetlands improve water quality. Anthropogenic activities associated with urbanization influence wetlands mainly through altering the dynamics of nutrients. This research can assist in determining how well wetlands remove pollutants in the Nashville urban area. This research is carried out on the TSU research wetland located at the greenhouse facility. A specific objective is to estimate the removal efficiency of nutrients. This study evaluates the physicochemical parameters of water quality in the wetland. Results have shown a (32%, 25%, 8% & 3%) removal efficiency for (S, Na, Ca & P) respectively. Variations in DO, specific conductivity and salinity have been observed.

Distribution of sea urchin density and community structure in different habitats along the northeastern coast of Trinidad. **Markeyta Bledsoe\*** and **Stanton G. Belford**, *Martin Methodist College, Pulaski, Tennessee*. The rock-boring sea urchin (*Echinometra lucunta*) is a species widely distributed throughout the Caribbean and provides an ideal study animal to determine how species density relates to distribution in different habitats. We used 1 m<sup>2</sup> quadrats to determine densities and benthic structure at Pequelle Bay (PB) and Grande L'Anse (TB) in June 2015 and 2016. We measured and weighed sea urchins from habitats subjected to heavy wave action and habitats with low wave action.

Results showed sea urchin densities at 30 individuals per m<sup>2</sup> (N=21) at PB and 33 individuals per m<sup>2</sup> (N=13) at TB. Sea urchins in habitat with low wave action had significantly larger test diameter for the red color morphotype (t-test = 2.25, p<0.05), and black color morph in (t-test = 2.67, p<0.05) at PB. At TB, red color morphs weighed significantly more in habitats with low wave action (t-test = 2.17, p<0.05).

Development of an eDNA sampling protocol to identify streamside salamander (*Ambystoma barbouri*) populations in Middle Tennessee. **Nicole Witzel\*** and **William B. Sutton**, *Tennessee State University, Nashville, Tennessee*. The streamside salamander (*Ambystoma barbouri*) occurs in Middle Tennessee, where it is geographically isolated. This salamander is active during winter and spring when it breeds in low-order, seasonal streams. These animals are only surface-active for several months and can be difficult to detect using traditional methods. Surveys targeting environmental DNA in the form of sloughed skin, sperm, and eggs provide a potentially effective method for detection. Before this method can be used, it is essential to develop species-specific primers for the target species. The objective of this study was to identify a primer specific to *Ambystoma barbouri* DNA. A primer was selected by choosing cytochrome B mitochondrial DNA segments with base pairs that differed from another closely related species. The primer will be used to amplify *Ambystoma barbouri* DNA and tested to see if it will amplify the DNA of any of the other ambystomatids of Tennessee to examine specificity.

Investigating the effect of pesticides on soil microbe cultures. **Ashleigh Roeser\***, **Emily Best\***, **Ali Green\***, **Araceli Lopez\***, **Sequence Mccollough\***, **Taylor Orr\***, and **John P. DiVincenzo**, *Middle Tennessee State University, Murfreesboro, Tennessee*. It is important to understand how the application of pesticides affects the viability of soil microflora, and more specifically nitrifying bacteria, which are responsible for converting ammonia to nitrate, providing plants with necessary nutrients. Fluorescent spectroscopy and microscopy will be used to determine the ratio of living to dead cells in soil microbe cultures after exposure to pesticides, and a CO<sub>2</sub> trap will be used to monitor respiration. Both of these methods have been tested on *E. coli* cultures. Ion chromatography has been successfully utilized to monitor nitrate production and develop an optimal media for culturing soil nitrifiers. A derivative of the most probable number (MPN) method was used to monitor acid production by nitrifiers as an indicator of the viability of the culture and will be used again to track growth after inoculation with pesticides. Methods for monitoring the health of soil microbes are essential to understanding pesticide impacts.

Comparison between established versus newly created green roofs focusing on microbiology, macroinvertebrates and green roof flora. **Kelsey Saint Clair\***, **Chris Barton** and **A. Darlene Panvini**, *Belmont University, Nashville Tennessee*.

Green roofs enhance urban diversity by creating green spaces in metropolis settings. Little research has examined the relationship between soil microbial, macroinvertebrate, and plant diversity on green roofs. We compared diversity on two green roofs at different stages: established versus newly-established. We predicted that the older green roof would have more species diversity. DNA barcoding was used to identify plants to genus level, pitfall traps and sweep nets were used to determine macroinvertebrate diversity, and Ecoplates were used to assess microbial functional diversity. The newly-established green roof exhibited more species of plants per area and more structural complexity. Greater diversity of macroinvertebrates and bacteria were also found on the newer green roof. The intermediate disturbance hypothesis could explain the greater diversity on the new green roof. If we know how diversity changes over time, this research can provide insight into how green roofs can be managed to enhance urban diversity.

Differences in plant, macroinvertebrate, and microbiota diversity on a well-established green roof and a new green roof. **Sargoel Rezanejad\***, **Chris Barton** and **A. Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Green roofs, patches of vegetation on the roofs of buildings, provide many economic benefits for humans. They also help restore biodiversity by housing diverse species of organisms that interact to provide structural diversity and ecosystem functionality. DNA barcoding, a modern taxonomic tool, is a more recent technology used to identify organisms to the species level. We collected plants, macroinvertebrates, and bacteria from two different green roofs (an old one and a new one) on a university campus in Nashville, Tennessee to assess diversity while examining DNA barcoding as a taxonomic tool. Pitfall traps, sweep nets, and Ecoplates were used to determine macroinvertebrate and microbial diversity. The newly-established green roof exhibited more species of plants per area and more structural complexity, thus greater diversity of macroinvertebrates and bacteria. This suggests a relationship between plant structural complexity and overall diversity. DNA barcoding was mostly effective in identifying plants to the genus level.

### Engineering and Engineering Technology

In-process void detection with magneto-elastic rate of change torque sensor. **Thomas Ruland\*** and **William Longhurst**, *Austin Peay State University, Clarksville, Tennessee*. Void detection in welds is often destructive or does not show enough detail to find small voids; in-process void detection normally requires strain gauges and still has to have a Fourier transform applied to get reasonable results. In-process void detection allows for fewer mechanical failures of welds. Our magneto-elastic rate of change torque sensor consisted of a magnetized friction stir welding bit and a coil of wire consisting of 330 turns. A magneto-elastic rate of

change torque sensor gives live results and does not require a Fourier transform to get usable data unlike strain gauges. One eighth inch holes were placed in aluminum 2" apart to test the viability of this sensor. The sensor signal changed as torque was applied to the tool bit and also at the voids there was a change in the signal. We were successful in detecting 1/8" voids using the magneto-elastic rate of change torque sensor.

### Geology and Geography

In the face of danger: applying fundamental meteorological concepts to an emergency management simulation. **T. Binkley\*** and **C. Karmosky**, *The University of Tennessee at Martin, Martin, Tennessee, and State University of New York College at Oneonta, Oneonta, New York*. This project used a simulation of a land-falling hurricane to engage students with fundamental emergency management skills. Emergency management and meteorology careers both require fast, educated decisions made under intense pressure. One career path for students taking meteorology classes is emergency management though many meteorology classes ignore this practical use of course material. Through this practical exercise, students have the ability to make the same types of decisions in the same environment under a simulated, but realistic time constraint. Afterwards, students filled out a survey about their experience and what they gained. This allows the researchers to see how students apply the knowledge from classroom lectures into real life situations, can gauge how well they retain the information, and increase critical thinking skills. We also present complete lesson plans, including PowerPoint presentations and materials, so that others may conduct the same simulation in their own classrooms.

Hydrology of an urban wetland at Tennessee State University. **JeTara Brown\*** and **Lonnie Sharpe**, *Tennessee State University, Nashville, Tennessee (JTB, LS) and U.S. Geological Survey, Nashville, Tennessee (TB)*. Tennessee State University is a historically black college/university founded in 1912 as a public land grant institution. The 500 square acre main campus is not only home to thousands of students, but also to a unique biodiversity of ducks, turtles, and beavers that thrive at a wetland located in the northern region of the campus. The wetland was formed after persistent beavers moved into the area and built several dams along a drainage ditch that flooded the lowland for several years after an urban watershed was modified for road construction. The objective of this study was to illustrate the transformation from storm-drainage ditch to marsh wetland using GIS, and evaluate hydrology. Studies have been conducted from 2008 to 2016. The watershed grew from a 4-foot wide drainage ditch to a 26-acre marsh. Old roads and animal pastures have now been replaced by standing water, cattails, and other wetland plants.

Road curvature analysis for building a motorcycle route. **Samuel Dotson\***, **Benjamin Drury** and **Peter Li**, *Tennessee Technological University, Cookeville, Tennessee*. Due to high curvatures certain roads have become popular among motorcyclists (e.g. Tail of the Dragon). Unknown to many, Tennessee's Upper Cumberland Region is filled with high curvature roads, yet knowledge is limited on their locations and no one to date has studied them in relation to generating motorcycle routes using geographic information systems. Our intent was to design a workflow for generating motorcycle routes in ArcGIS to advance regional tourism. Road curvature was determined through the dot product method and sinuosity. These values then acted as weights for *Dijkstra's algorithm*. Altering the traditional weight(s) (i.e. time, distance) to either the angle or sinuosity significantly altered the resulting route. Unfortunately, it remains difficult to quantify or compare these results to make further improvements. Hopefully in future studies we will be able to improve these results by readjusting the weights or by using a routing algorithm other than *Dijkstra's*.

Water quality monitoring along streams and tributaries in the Roaring River watershed, Overton and Jackson counties Tennessee. **Wesley D. Flatt\*** and **Peter Li**, *Tennessee Technological University, Cookeville, Tennessee*. The Roaring River flows into the Cumberland River which is a major source of water for the Upper Cumberland area. The primary land use groups in this area are deciduous forests and pasture around most of the streams. Physical parameters such as pH, TDS, dissolved oxygen, and conductivity were tested from sampling locations in the watershed. Findings from the measurements show pH averaging 7, TDS averaging 165, dissolved oxygen varying from 4.5 mg/L to as much as 9.2 mg/L, and conductivity varying as well from 208  $\mu$ S to 491  $\mu$ S. GIS mappings present locational variations from sites in the watershed. Correlation between land use patterns and order of the streams are presented in the final results.

Radon gas present in karst areas. **Alexander D. Nicely\*** and **Jon R. Zetterberg**, *Tennessee Technological University, Cookeville, Tennessee*. Radon gas is believed to be one of the largest causes of lung cancer, second only to smoking. The purpose of this experiment was to find a correlation between the intensity of radon exposure and the proximity to karst geology. Homes located near a known cave system in Cookeville, Tennessee were tested for radon over a span of three to five days. The levels of radon, measured in picocuries per liter of air (pCi/l), were then compared to factors such as cave or sinkhole proximity, elevation, temperature, and air pressure. After enough data was collected, it was evident that the proximity to karst areas did affect radon exposure. However, temperature was shown to have the greatest influence on the intensity of the gas exposure. All homes were tested in late spring. The goal is now to re-test these homes in the fall to accurately determine temperature's effect on radon levels.

The Earth hemispheres and their average elevations. **A. Tan, A. Alomari\* and M. Schamschula, Alabama A & M University, Normal, Alabama.** The division of the Earth's surface into Land and Water Hemispheres is found in the literature. The Land Hemisphere, centered at 47°N, 2°W, contains about 85% of the land surface of the Earth, whereas the Water Hemisphere, centered at 47°S, 178°W, contains the remaining 15%. In this study, the mean elevations of various hemispheres were calculated or estimated from satellite geoid data. The results are the following: (1) For an ideal pear-shaped Earth, the mean elevations of the Northern and Southern Hemispheres are -2.546 m and 2.546 m, respectively; (2) For the actual Earth, the mean elevations of the Northern and Southern Hemispheres are -1.888 m and 2.010 m, respectively; and (3) For the Land and Water Hemispheres, the respective mean elevations are -3.370 m and 3.511 m, respectively.

The principle of isostasy applied to Land and Water Hemispheres of the Earth. **A. Tan, A. Alomari\* and M. Schamschula, Alabama A & M University, Normal, Alabama.** The Principle of isostasy has been applied on a global scale to explain the pear-shape of the Earth. It was found that the longitudinally averaged percentage of water bears a significant correlation coefficient of .630 with the longitudinally averaged geoid height. It was suggested that this correlation was likely to be causal rather than accidental. In this study, the same principle is applied to the Land and Water Hemispheres, where the correlation coefficients increased to .669 and .725, respectively. The results reinforce the notion of the dependence of the longitudinally averaged geoid height upon the longitudinally averaged percentage of water and thus re-affirms the applicability of the Principle of Isostasy on a global scale.

### Health and Medical Sciences

Homemade vegan and gluten-free breakfast bars. **Corinna Rankin\*, Dominique Gibbs and Tara Sexton, The University of Memphis, Memphis, Tennessee.** The Academy of Nutrition of Dietetics (AND) states that breakfast should aim to include 20% of the Daily Value of as many nutrients as possible. Each member of the research group selected one of four homemade standard breakfast bars. It was then modified to meet favorable sensory evaluation standards, specified flavor profile, and 1/3 daily macronutrient requirements. Once achieved a blind sensory evaluation session was conducted using untrained peer panelists (14). The standard and experimental products were evaluated using a sensory evaluation scorecard by assessing six different aspects on a 100 mm sliding scale. The sensory evaluation session consisted of two rounds to yield a total of 28 data points for each product. The overall sensory evaluation results were favorable; all research's met the improved specified flavor profile, a vegan product free of gluten, and met some but not all 1/3 daily macronutrient requirements.

Convallatoxin induces apoptosis in HCT116 colorectal cancer cells. **Sarah Anderson\* and Chris Barton, Belmont University, Nashville, Tennessee.** Cardiac glycosides have been reported to induce cellular arrest in specific cancer cells lines by attacking the Na<sup>+</sup>/K<sup>+</sup> ATPase pump. Convallatoxin, one of the cardiac glycosides, has been reported to be effective in inducing apoptosis in 142B human osteosarcoma cells and HeLa cervical cancer cells by attacking a specific subunit of the Na<sup>+</sup>/K<sup>+</sup> ATPase pump. This research aimed to study the effects of convallatoxin on HCT116 colorectal cancer cells in both wild-type and p53 null cell lines. Cells were treated with 50 nM convallatoxin for a 24 and 48-hour time period to visualize signs of apoptosis and decline in mitotic activity. The findings demonstrated that convallatoxin was effective in inducing apoptosis in both the HCT116 wild-type and p53 null cell lines.

Effects of arsenic trioxide (As<sub>2</sub>O<sub>3</sub>) on the *in vitro* release of thyroxine from incubated bullfrog (*Lithobates catesbiana*) thyroid glands. **Emily A. Ely\* and Dominic L. Palazzolo, Lincoln Memorial University-DeBusk College of Osteopathic Medicine, Harrogate, Tennessee.** We previously demonstrated that As<sub>2</sub>O<sub>3</sub> inhibits thyroid peroxidase activity. Consequently, we hypothesized that As<sub>2</sub>O<sub>3</sub> disrupts physiological thyroid control mechanisms. To test this hypothesis, we investigated the ability of As<sub>2</sub>O<sub>3</sub> to disrupt these control mechanisms by assessing its effects on thyroxine synthesis and release, *in vitro*. Bullfrog thyroid glands were incubated in frog ringer saline (FRS) in the absence or presence of As<sub>2</sub>O<sub>3</sub> for 72 hours in which FRS was collected and replaced every 24 hours for measurement of thyroxine release. During the second 24-hour period, thyroid glands were exposed to bovine thyroid stimulating hormone (bTSH). At the end of the third 24-hour incubation period, thyroid glands were analyzed for thyroxine content. The results indicate that bTSH stimulates thyroxine synthesis and release in the absence of As<sub>2</sub>O<sub>3</sub>. In contrast, the presence of As<sub>2</sub>O<sub>3</sub> inhibits bTSH-induced thyroxine synthesis and release, supporting our hypothesis that As<sub>2</sub>O<sub>3</sub> disrupts thyroid physiological control mechanisms.

Effects of epigallocatechin-gallate and enoxacin on HeLa cells. **Anna Margaret McDonnell\* and Chris Barton, Belmont University, Nashville, Tennessee.** Fluoroquinolone antibacterial drugs, such as enoxacin, have shown in recent studies to have antitumoral properties. Similarly, green tea polyphenols, such as epigallocatechin-gallate (EGCG), have shown to be effective antitumoral and synergistic agents. However, the effects of these drugs on cervical adenocarcinomas have not been fully established. Cervical adenocarcinoma is an aggressive cancer of the endocervical lining. Novel chemotherapeutics are needed to circumvent harsh side effects of currently used treatments for this carcinoma. Here, we detail the effectiveness of both enoxacin and EGCG as antitumoral agents in HeLa adenocarcinoma cells. Both drugs showed significantly lower viability and increased amounts of apoptosis compared to untreated

controls. Additionally, the drugs in combination show an additive effect on HeLa cells. In conclusion, these findings indicate the effectiveness of enoxacin and EGCG both individually and in conjunction as antitumoral agents against cervical adenocarcinoma *in vitro*.

Nicotine in electronic cigarette refill solutions (E-liquids): a comparison of five brands of refill solutions purchased locally. **Zuri Hudson\***, **John Nelson** and **Dominic L. Palazzolo**, *Lincoln Memorial University-DeBusk College of Osteopathic Medicine, Harrogate, Tennessee*. E-liquids are under scrutiny concerning the accuracy of nicotine concentrations printed on the product's label. In this investigation, we determined the concentrations of nicotine in six brands (7's, Puff, Sweet Southern Vapes, LEX12, V2 and LMU) of locally available E-liquids and report the difference from the concentration printed on the product's label. The LMU brand was prepared in our laboratory and served as a reference. Three bottles of each E-liquid were analyzed ( $n=3$ /bottle). Nicotine concentrations were determined using HPLC-PDA. Nicotine (mean  $\pm$  SEM) in 7's, Puff, Sweet Southern Vapes, LEX12, V2 and LMU were  $17.8\pm 4.1$ ,  $23.2\pm 0.7$ ,  $24.0\pm 0.9$ ,  $24.9\pm 0.2$ ,  $19.7\pm 0.3$  and  $20.4\pm 0.1$  mg/ml, respectively. Concentrations normalized to 100% of product label were 74%, 102%, 104%, 104%, 112% and 102%, respectively. The 7's brand showed significance ( $p<0.005$ ) between bottles, while the LMU brand showed the least variability. These results demonstrate the need for rigorous quality control in preparing E-liquids for consumer use.

Investigation of p53 activation in HCT116 with the sesquiterpene Beta-Caryophyllene. **Diana S. Neculcea\*** and **Chris Barton**, *Belmont University, Nashville, Tennessee*. Beta-caryophyllene is a natural bicyclic sesquiterpene widely found in the essential oils of many common herbs and plants. The biologic properties of *B-caryophyllene* have experimentally demonstrated anti-proliferative, antioxidant, antimicrobial, and anti-inflammatory effects. In this experiment, we investigated variances in the anti-proliferative effects of *B-caryophyllene* on the isogenic human colorectal cancer cell line HCT116 with wild-type p53 (+/+) and HCT116 without p53 (-/-). Both conditions showed a dose-dependent response in cell growth inhibition to treatment with increasing concentrations of *B-caryophyllene*. The nontoxic dose of 150  $\mu$ M *B-caryophyllene* significantly decreased the mitotic cell count in the p53 (+/+) HCT116 by over 50% in the first 24-hours. The same IC50 value was used with the p53 (-/-) cells for consistency, however there was only a 10% decrease in the first 24 hours. This discovery advocates that the presence of p53 may play a role in the effectiveness of *B-caryophyllene* as an anticancer agent.

Confronting otherness in a health care educational setting. **T. L. Smith**, **C. A. Ralston\*** and **C. Ewing\***, *School of Health Studies, The University of Memphis, Memphis, Tennessee*. Health care students and educators regularly encounter

otherness. Alarming, assigning otherness comes with risks. The purpose of this project was to construct divergent dialogues with the nature of experienced otherness within "our" own personal spheres. Three researchers, a faculty member in health studies, a graduate student dietetic intern, and an undergraduate nursing student, each sought to understand and examine the nature of otherness experiences in their daily lives. For the faculty member the most important otherness encounter is with students and ignorance of otherness may diminish opportunities for care. For the graduate student, otherness was a foreign concept when first introduced. It seemed like an invisible cloud, being present but not recognizable. For the undergraduate student otherness was a familiar, but not yet labeled construct. The outcomes for each researcher varied and included deepening concern, mindfulness, and recognition. The researchers concluded that confronting otherness is challenging, rewarding and necessary.

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

Treatment effects of emetine on HCT-116 cells. **Kerry Sommers\*** and **Chris Barton**, *Belmont University, Nashville, Tennessee*. Emetine, a natural compound originating from ipecac roots, has been utilized as a chemotherapeutic agent due to its apoptosis-inducing effects. Emetine has been used primarily for the treatment of lung and blood borne cancers, however there is little research on emetine's effects on colon cancer. This study addresses the effect of emetine on the proliferation and death of HCT-116 colorectal cancer cells. The cells were treated with three different concentrations of emetine over three time points. After determining that emetine had the capacity to kill the colon cancer cells, fluorescent microscopy was used to determine the mode of cellular death. The results of the microscopy analysis revealed that emetine inhibited proliferation and induced apoptotic cell death in the HCT-116 cells.

Factors associated with postpartum contraceptive choice. **Elly Riley, Michael Fister\*, Claire Pendergrass\*, Emily Towery\*, John White, Saurabh Sachan, and Dustin Temple, The University of Tennessee Health Science Center, Memphis, Tennessee.** Contraceptives are an important aspect of family planning, especially when a rapid repeat pregnancy is not desired. The purpose of this QI study was to review postpartum contraceptive counseling practices at UT Family Medicine-Jackson (UTFM-J) and to recommend the best way to counsel pregnant patients. A search of the UTMF-J EMR was done; 791 patients were identified who came in for a routine postpartum examination (randomized to a list of 300, n = 279 after exclusions). Data was collected from the EMR and Chi-square tests of independence were performed to examine relationships between patient age and contraceptive choice ( $p < 0.001$ ), and patient race and contraceptive choice ( $p = 0.001$ ). Depo was a frequent choice among patients (56/279) but had low adherence rates (16.1% on time for one year). It is recommended that physicians counsel all pregnant patients thoroughly on contraception options and their efficacies before the postpartum visit.

NFAT5/STAT3 Interaction Mediates Synergism of High Salt with IL-17 towards Induction of VEGF-A Expression in Breast Cancer Cells. **Suneetha Amara, Dalal Alotaibi and Venkataswarup Tiriveedhi\*, Mercy Hospital, St. Louis, Missouri; Tennessee State University, Brentwood, Tennessee; and Tennessee State University, Nashville, Tennessee.** The synergistic role of high salt with IL-17 towards induction of VEGF-A was investigated. Stimulation of MCF-7 breast cancer cells with high salt (0.2 M NaCl) and sub minimal IL-17 (1 ng/ml) enhanced the expression of VEGF-A (2.9 and 2.6 fold, respectively,  $P < 0.05$ ) against untreated cells. Co-treatment with high salt and sub minimal IL-17 led to a 5.9 fold increase in VEGF-A expression ( $P < 0.01$ ), suggesting a synergistic role. VEGF-A promoter analysis and specific small interfering RNA knock down of transcription factors revealed that high salt induced VEGF-A expression through nuclear factor of activated T cells (NFAT)5, while IL-17 induced VEGF-A expression via signal transducer and activator of transcription (STAT)3 signaling mechanisms. These data suggest that high salt levels synergize with pro inflammatory IL-17 to potentially induce cancer progression and metastasis through VEGF-A expression. Low salt diet, anti NFAT5 and anti- STAT3 therapies may provide novel avenues for enhanced current cancer therapy.

### Microbiology

Identification of Amidase negative strains of *Bacillus thuringiensis*. **Sarah Filfilan\*, Anthony Ejiofor and Terrance Johnson, Tennessee State University, Nashville, Tennessee.** *Bacillus thuringiensis* (*Bt*) is largely used in agriculture, especially organic farming as a bioinsecticide. Amidase is the enzyme that breaks down the cell wall structure of the sporangium, which exposes the crystal proteins to UV light

neutralizing them. Therefore, *Bt* cells that do not have amidase genes are possible targets for genetic engineering crystal protein products. In the work reported here DNA was extracted from 30 strains of *Bt* and subjected to PCR analysis using eight different sets of primers to detect amidase genes. It was found that most of the strains tested yielded PCR products from each of the primer sets. However, seven strains were found to not produce a PCR product by four of the primer sets. Thus, it was concluded that these strains will serve as targets for further study to develop a *Bt* strain that does not break down the sporangium.

Characterization of Poly-3-hydroxybutyrate (PHB) produced by *Bacillus cereus* tsul using rapeseed cake substrate. **Hui Li\*, Suping Zhou. Tennessee State University, Nashville, Tennessee.** Polyhydroxyalkanoates is a family of biodegradable, biocompatible thermoplastics, which can be utilized in applications important to agriculture, package and health-care. In previous work, we have reported the isolation and genome sequence analysis of *Bacillus cereus* strain tsul NCBI accession No. JPYN00000000. Genes encoding for the poly-3-hydroxybutyrate (PHB) biosynthesis pathway were identified in the assembled genome sequences. The efficiency of PHB production of this bacterial strain grown in rapeseed cake substrate was analyzed using a batch culture system. The physical properties were comparable to the standard compound from Sigma (catalog# 363502) when analyzed with Raman spectra and Fourier transform infrared spectroscopy (FTIR). The five PHA genes (beta-ketothiolase, Phasin, acetoacetyl-coA reductase, PhaR synthase subunit, PhaC\_N synthase subunit) were cloned, the recombinant proteins were analyzed by mass spectrometry analysis.

Cloning and characterization of multifunctional cellulolytic enzymes screened from metagenomic resources representing ruminal bacteria in the goat. **Santosh Thapa, Hui Li, Sarabjit Bhatti, Suping Zhou. Tennessee State University, Nashville, Tennessee.** Metagenomic resources representing ruminal bacteria that produce cellulolytic and hemicellulolytic enzymes were screened, isolated and identified from the uncatalogued microorganisms in the goat rumen. Metagenome DNA was extracted and sequenced using next-generation sequencing. The amplified PCR products were cloned and further sub-cloned using TA and TOPO cloning strategy respectively. Gene sequences were confirmed using Sanger sequencing and submitted to NCBI database. The genes encoding endo 1, 6 beta D-glucanase were functionally expressed in *Escherichia coli* demonstrating cellulolytic activities, which can then be tested on various substrate to construct highly active recombinant enzymes applicable for different biotechnological tasks.

Possibility of toxic indole production by bacteria in human guts. **Emily Alyse Wysocki\*, Emery White\* and Sergei A. Markov, Austin Peay State University, Clarksville, Tennes-**

see. Amino acid tryptophan can be metabolically converted into indole by certain types of bacteria in human intestines. It is possible that high concentrations of indole can be toxic to human cells, so it may be useful to know what tryptophan-containing foods that yield the most indole by enteric bacteria. Different food sources containing tryptophan were added to mineral growth media to test if bacteria produce indole. Our model bacterium was *Escherichia coli*, one of the possible inhabitants of human guts. Most food samples tested (24 in total) in our experiments showed positive for indole production, but none in very high amounts. This data can be used in future recommendations for food industries.

### Physics and Astronomy

Preparation and characterization of spin coated arsenic selenide thin films. **Maria V. White\***, **Caity Thomas\***, **Joshua Allen\***, **Jonathan Bunton\***, and **Andriy Kovalskiy**, *Austin Peay State University, Clarksville, Tennessee*. Chalcogenide glasses possess a set of unique properties that make them favorable in many optical applications. Chalcogenide glass thin films can be made by different methods. We use spin coating technology based on chemical dissolution of bulk arsenic selenide glasses in ethylenediamine. Such films have structure very similar to the bulk analogue. As a result, it is expected that they should be photo-stable at the irradiation by visible light. Technological features of spin coating method for the arsenic selenide were studied. It was found that chemical environment plays an essential role in the process of preparation of the optical quality material. The highest quality films have been obtained in inert gas environment without any contact with oxygen. Raman spectroscopy was used for structural characterization of the prepared samples. Photo-induced optical effects were studied by irradiating the thin chalcogenide film with light of different energy and intensity.

Comparison of photo-response of thermally deposited and spin-coated arsenic sulphide thin films. **Josh Allen\***, **Jonathan Bunton\***, **Caity Thomas\***, **Maria White\***, **Stanislav Slang**, **Miroslav Vlcek**, **Tetyana Ignatova**, and **Andriy Kovalskiy**, *Austin Peay State University, Clarksville, Tennessee (JA, JB, CT, MW, AK)*; *University of Pardubice, Pardubice, Czech Republic (SS, MV)*; and *Lehigh University, Bethlehem, Pennsylvania (TI)*. Chalcogenide glass thin films are promising materials for optical recording, photonics, and other applications which require substantial photo-induced optical effects in various regions of the light spectrum. It is known that thermally deposited thin films of chalcogenide glasses are photo-sensitive under bandgap and UV irradiations. Thin films obtained by spin coating technology are expected to be photostable at these irradiation conditions because of their structural similarity with bulk glasses. We prepared both thermally deposited and spin coated thin films of stoichiometric As<sub>40</sub>S<sub>60</sub> and S-rich As<sub>28</sub>S<sub>72</sub> compositions.

Induced changes of optical transmission under different irradiation conditions were studied. It was confirmed that thermally deposited films are characterized by prolonged irreversible and reversible components of photodarkening. At the same time, spin coated films revealed significant reversible photo induced effects when exposed to intense (~200 mW) UV light. Structure of freshly prepared and irradiated films was studied by Raman microscopy.

Fluorescence of Er-doped CsCl-Ga-Ge-S glasses for IR applications. **Jonathan Bunton\***, **Oleh Shpotyuk**, **Laurent Calvez**, and **Roman Golovchak**, *Austin Peay State University, Clarksville, Tennessee (JB, RG)*; *Jan Dlugosz University, Czestochowa, Poland (OSh)*; and *Université de Rennes, Rennes Cedex, France (LC)*. CsCl modified Ga-containing germanium sulfide glasses and glass-ceramics provide one of the best host matrixes for rare-earth elements, which have many potential applications in optical sensing, as active media for lasers, optical amplifiers and broad band sources in the mid-IR spectral range. In this work, the room- and low-temperature (liquid nitrogen) fluorescence of 65GeS<sub>2</sub>-25Ga<sub>2</sub>S<sub>3</sub>-10CsCl glasses doped with Er has been investigated. The emission spectra were recorded in 1000-1700 nm range of wavelengths, using different excitation wavelengths from 300-950 nm spectral range (Horiba Fluorolog-3 spectrometer). Strong emission lines at ~1.55 μm were observed at room temperature for Er-doped samples excited with ~530 nm wavelength. At cryogenic temperature, the excitation wavelength for this emission line was found to gradually shift towards lower values (~400-450 nm). The observed emission lines agree well with known energy levels transitions of Er<sup>3+</sup> ions incorporated in glass matrix.

Fluorescence of Pd-doped Ti:CMAS glass and ceramics. **Laura Nichols\*** and **Roman Golovchak**, *Austin Peay State University, Clarksville, Tennessee*. Room- and low (liquid nitrogen)-temperature fluorescence is measured for novel Pd-doped Ti-containing calcium magnesium aluminosilicate (Ti:CMAS) glasses and glass-ceramics prepared in air and forming gas atmospheres. A broad fluorescence peak at ~560 nm from F<sup>+</sup> color centers, observed at 77 K in Pd-free and Pd-doped Ti:CMAS parent glasses under the excitation wavelengths of 300-320 nm, suggests the presence of oxygen defects in the vicinity of titanium ions. These defective titanium octahedra (TiO<sub>n</sub>, n<6) are assumed to be found in close proximity in the structure of parent glasses. Glass-ceramics made in forming gas do not show any fluorescence at all, while the samples ceramized in air show blue emission at ~490 nm at low temperature under the excitation wavelengths of 260-280 nm. This fluorescence is associated with UV-excited transition from the 2p orbits of the surrounding oxygen ion to the vacant outer 3d orbit of Ti<sup>4+</sup>, followed by the radiative annihilation.

Electromagnetic pump comprised of common off-the-shelf components to displace a salt-water solution. **Cade T. Friedland\***, **J. Alexandra Keith\*** and **William R. Longhurst**,

*Austin Peay State University, Clarksville, Tennessee.* Electromagnetic pumps utilize an electrical current flowing through the working fluid and an external magnetic field to create pressure on the working fluid without the use of moving components that have historically been used in positive displacement and centrifugal pumps. Pumps with no moving parts would be advantageous for use in medical and space applications where maintenance and reliability issues are of great concern. Our investigation focused on using commercially available off-the-shelf components, simple fabrication techniques, and limited manufacturing resources. For the working fluid we used seawater (3.5% NaCl), which has an electrical resistance similar to human blood. Performance testing consisted of constructing pump curves to define the operational capability of the pump. The results show that using a 0.5 Tesla magnetic field, in conjunction with an electrical power source of a low voltage produces a pumping action that could be used in remote and isolated work environments.

Developing a flat field system for Austin Peay State University's 20-inch telescope. **Richard Borges\***, **Thomas Ruland\*** and **J. Allyn Smith**, *Austin Peay State University, Clarksville, Tennessee.* A flat field system was developed for Austin Peay State University's 20-inch telescope in order to correct for obstructions in the optical path while using the *ugriz* filter set. In order to achieve this purpose, LEDs were selected such that their peak wavelength would coincide with the center of each *ugriz* filter, these LEDs were placed in an array and a circuit was designed to power the LEDs. The power supply for the circuit was tested for linearity in current output. The LED output was measured to make sure that light output was constant and that the flat panel was uniformly illuminated. The flat field system has been constructed and testing is still ongoing. This flat field system will allow the Austin Peay State University observatory to image for the purpose of calibration and properly calibrate images to collect scientific data.

Spectroscopic reductions of white dwarf stars to support dark energy survey calibrations. **Deborah J. Gulledge\***, **Jacob M. Robertson\***, **Douglas L. Tucker**, **J. Allyn Smith**, **William Wester III**, **Pier-Emmanuel Tremblay**, and **Mees Fix**, *Austin Peay State University, Clarksville, Tennessee (DJG, JAS, JMR); Fermi National Accelerator Laboratory (DLT, WW); University of Warwick, Coventry, England (PET); and Space Telescope Science Institute, Baltimore, Maryland (MF).* The Dark Energy Survey is an imaging survey that covers 5000 square degrees in the Southern Hemisphere to map galaxies and gather information on dark energy. Science requirements for the survey require a 0.5% uncertainty in color, driven by supernova science. The Dark Energy Survey relies on a calibration technique that uses white dwarf stars to set the filter magnitude zero points. These white dwarf spectra are fit to models which are used to generate synthetic photometry. These values are compared to the measured values from the survey to verify that the

zero points are correct. We present results to date of the spectroscopic reductions of these white dwarf stars in support of the calibrations for the Dark Energy Survey.

Discovery of a new quasar: SDSS J022155.26-064916.6. **Jacob M. Robertson\***, **J. Allyn Smith\***, **Douglas L. Tucker**, **Huan Lin**, **Deborah J. Gulledge\*** and **Mees B. Fix**, *Austin Peay State University, Clarksville, Tennessee (JMR, JAS, DJG); Fermi National Accelerator Laboratory, Batavia, Illinois (DLT, HL); and Space Telescope Science Institute, Baltimore, Maryland (MBF).* We report the discovery of a new quasar: SDSS J022155.26-064916.6. The object was selected as a white dwarf candidate for a sample of spectrophotometric standards for the Dark Energy Survey. It was imaged by SDSS and classified as a star with a cosmic ray hit, but the quasar was not selected as a spectroscopic target for SDSS-III. WISE data place the object in the QSO/Seyfert range; however, no spectroscopic confirmation of the object as a quasar previously existed. In the investigation of this object as a potential white dwarf, the object was identified by its spectrum to be a quasar. The spectrum is presented with MgII, OII, H $\beta$ , and OIII identified, and the average redshift is determined to be  $z \approx 0.799 \pm 0.0086$ . The luminosity distance is  $D_L = 5074.7$  Mpc. The spectral energy distribution and a comparison with objects from the SDSS DR7 quasar catalog are also presented.

Fitting multi-periodicity in variable stars, a comparison of fitting programs, **Geoffrey S. Burks\*** and **Gregory W. Henry**, *Tennessee State University, Nashville, Tennessee.* Many variable stars are multi-periodic (e.g., gamma Dor stars, delta Scu stars). Data over many years are often taken to pin down these periods. Since data are not continuous in time, programs are used to fit period and amplitude of brightness variation. Projects using such data make a good introduction of undergraduates to astronomical research. Two often used sets of programs are applied to a good multiyear data set. The ability of fit period and amplitude are compared. A plausible method for obtaining publishable results by undergraduates is presented.

### Science and Mathematics Teaching

Astronomical methods and instrumentation involved in determining velocity dispersion and metallicity for globular clusters. **Jo Lynn Tyner\*** and **Christopher McDonald\***, *Austin Peay State University, Clarksville, Tennessee.* The process of determining radial velocity dispersions and metallicities of clusters and galaxies is fundamental to most disciplines of astronomy. Researchers use programs such as IRAF, TopCat, LabView, and a multitude of others to determine metallicity and radial velocity dispersion. The learning curve to become familiarized with these programs and to understand the applications of the determined values is a steep one that discourages new students from pursuing a career in astronomical research. We present a

solution to this problem in the form of an easy to follow walk through of the process, and a guide that shows students the scientific background behind the quantities determined. We have chosen to use the globular clusters M13 and M5 as example clusters due to the large volume of established data that exists already with which we can compare our results.

Addressing civic issues of unpreparedness for natural hazards in Tennessee. **Marilyn A. Kelley, Samuel M. Musili, Mark Abolins, and Judith Iriarte-Gross, Middle Tennessee State University, Murfreesboro, Tennessee.** In the fall 2015 semester, the Honors Contemporary Issues in Science class, in collaboration with the National Science Foundation's Interdisciplinary Teaching about Earth for a Sustainable Future (InTeGrate) researched natural hazards in Tennessee. Using the module, Map Your Hazards, students identified natural hazards risk zones. The purpose of this research project was to equip stakeholders such as high schools, with knowledge on natural hazards and their vulnerability to these hazards. A survey was administered to locals of Murfreesboro, TN and MTSU students to obtain current statistics on public knowledge of natural hazards such as tornadoes, floods, and earthquakes. With this knowledge, the authors hypothesized methods to educate high school students, faculty and their families with useful knowledge in the event of a natural hazard occurrence. This research project concluded with recommendations for preparedness and resource allocation for a safer and more prepared community.

Middle Tennessee State University ADVANCE: spotlight on changing the institutional culture to improve the recruitment, retention, and advancement of women STEM faculty. **Judith Iriarte-Gross, Brad Bartel, Wandi Ding, Jackie Eller, Karen Petersen, Michael Hein, Gretchen Webber, and Denielle Meyerink, Middle Tennessee State University, Murfreesboro, Tennessee.** Middle Tennessee State University has been shifting our focus from a master's large university to a doctoral research university. This repositioning has resulted in new Ph.D. programs, increased research responsibilities, and more focus on best practices for recruitment, retention and promotion of faculty. The MTSU ADVANCE (HRD-1409638) grant provided the opportunity to analyze experiences of women STEM faculty with the goal of promoting gender equity. Our campus climate survey and focus groups identified areas that indicate perceptions of gender disparities. We find statistically significant differences between the perceptions of women and men about evaluation processes, resource allocation, campus climate, and work-life balance. We also see gender differences in reasons for leaving MTSU, in assessment of salary and workload, in perception of fairness and in concerns about consistency and clarity of tenure and promotion processes. We will present findings from the climate survey and focus groups along with recommendations for policy change.

## Zoology

The correlation of bat activity and bat species richness with insect abundance and insect diversity at an urban pond vs. at a rural pond in Weakley County, Tennessee. **J. Rowdy Englert\*, Jack Grubaugh and Nancy Buschhaus, The University of Tennessee at Martin, Martin, Tennessee.** Bats forage for flying insects, and some of those insects have emerged as flying adults from an aquatic environment. The abundance and diversity of emergent insects are potentially correlated with the productivity of the pond in which the insects developed as larvae. Rural ponds that are in stable environments may have greater productivity than urban ponds in more disturbed areas. Our hypothesis was that a rural pond would have a higher diversity and abundance of insects, and those measures would be positively correlated to bat activity and bat species richness. During March to April and September to October 2016, we compared an urban pond on the UT Martin campus with a rural pond located near campus. We sampled bat activity and species richness using bat detectors. In addition, we sampled insect abundance and diversity with black light traps. Bat activity, bat species richness, and insect abundance were highest at the rural pond.

Wildlife use of livestock water troughs. **Russell Milam\*, Dan Taylor, Stuart Tuttle, Marcus Miller, and Nancy Buschhaus, The University of Tennessee at Martin, Martin, Tennessee (RM, NB); Bat Conservation International, Austin, Texas (DT); and USDA National Resources Conservation Service (ST, MM).** Many factors influence availability and quality of natural water sources that wildlife might use on the landscape. However, when natural water sources are unavailable or undesirable, wildlife may opportunistically exploit artificial water sources provided for livestock. During July to September 2016, we collected data at 16 livestock water troughs located in three states (Tennessee, Kentucky, and Georgia). We examined the frequency of wildlife encounters with a trough, the type of wildlife using these troughs, and the characteristics of each trough. We recorded wildlife use by collecting scan and focal samples for 48 hours at each water trough using three game cameras per trough, and we used a bat detector at each trough to record bat activity in the local area. Several species of wildlife were observed using and/or interacting with water troughs in our study, suggesting that livestock troughs might be an important alternative source of water for some wildlife.

A comparison of bat activity at an urban and a rural pond in northwest Tennessee. **Brittany Woodard\*, Catherine Hixson\* and Nancy Buschhaus, The University of Tennessee at Martin, Martin, Tennessee.** Bats may use urban ponds as a source of water and emergent insects, but urban ponds may not provide suitable roost trees that are more common in rural environments. Our hypothesis was that bat activity would be affected by location, time of year, time of night, and temperature. We predicted that lower bat activity would