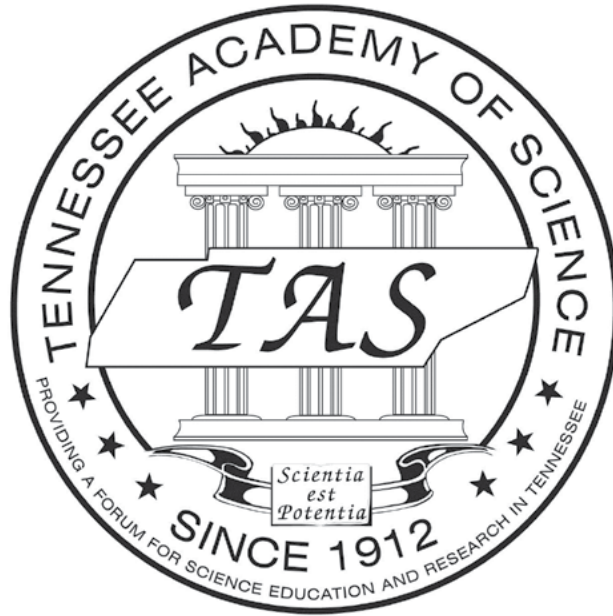


**132<sup>nd</sup> Meeting  
of the  
Tennessee Academy of Science**



**November 18, 2022**

**This meeting is hosted by Tennessee State University**

**Celebrating 110 Years**

## **Tennessee Academy of Science Institutional Sustaining Members**

Austin Peay State University  
East Tennessee State University  
Middle Tennessee State University  
Motlow State Community College  
Rhodes College  
Tennessee State University  
Tennessee Technological University  
The University of Tennessee at Martin  
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## **Tennessee Academy of Science Affiliated Societies**

American Association for the Advancement of Science  
Barnard-Seyfert Astronomical Society  
Clarence T. Jones Memorial Observatory  
National Association of Academies of Sciences  
Tennessee Association of Science Department Chairs  
Tennessee Entomological Society  
Tennessee Junior Science and Humanities Symposium  
Tennessee Psychological Association  
Tennessee Science Teachers Association

## ***TAS Future Annual Meeting Sites***

2023 – Rhodes College  
2024 – Lincoln Memorial University  
2025 – Pellissippi State Community College

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## **Welcome . . .**

... to the 2022 Annual Meeting of the Tennessee Academy of Science! We hope you enjoy and benefit from this opportunity to present your research, to learn of other research going on in Tennessee, to interact in a relaxed atmosphere with other science professionals and to participate in the business of the Academy. We are always striving to improve our Academy and its impact upon scientists in Tennessee and beyond.

## **Thank you . . .**

... to Tennessee State University for hosting our meeting!

... to Drs. Reginald Archer and Thomas Byl for serving as the Chairs of the Local Arrangements Committee! We appreciate all that you have done to host this meeting.

## **Announcements . . .**

If they are not already TAS members, presenters and attendees may become members by mail or on the TAS website: [www.tennacadofsci.org](http://www.tennacadofsci.org)

Dues can be paid in advance of the Annual Meeting or online.

Student \$10 annually

Emeritus \$10 annually

Member \$40 annually

Sustaining \$50 annually

Supporting \$100 annually

Life \$400 single payment In advance of the Annual Meeting

Membership forms can be mailed to the TAS Treasurer: Dr. Steve Murphree,  
Department of Biology, Belmont University, 1900 Belmont Boulevard, Nashville, TN  
37212-3757

**Undergraduate Students:  
Plan to present your research in Spring 2023 at your Division  
Meeting**

**Tennessee Academy of Science Collegiate Meetings  
Spring 2023**

For details and abstract deadlines: Collegiate Meeting link  
at <https://www.tennacadofsci.org/>

**East Tennessee Collegiate Division Meeting**

Friday, April 21, 2023  
Pellissippi State Community College  
Knoxville, TN

**Middle Tennessee Collegiate Division Meeting**

Saturday, April 15, 2023  
Volunteer State Community College  
Gallatin, TN

**Western Tennessee Collegiate Division Meeting**

Saturday, April 15, 2023  
Christian Brothers University  
Memphis, TN

Contact Dr. Darlene Panvini ([darlene.panvini@belmont.edu](mailto:darlene.panvini@belmont.edu)) regarding Collegiate  
meetings in general.

## Meeting Schedule

Zoom links can be found on the Annual Meeting Web page  
[http://www.tennacadofsci.org/annual\\_meeting/general\\_info.php](http://www.tennacadofsci.org/annual_meeting/general_info.php))

**All times listed are CENTRAL STANDARD TIME**

### Thursday, November 17, 2022

4:00 – 8:30 PM	<b>Executive Committee Meeting;</b> Farrell Westbrook room 117-119
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### Friday, November 18, 2022

7:30 a.m. until 1:30 p.m.	<b>Registration, Fredrick Humphries Complex Lobby</b>
8:15 a.m. until 8:30 a.m.	<b>Poster Session Sign In, Humphries Hall near registration</b>
8:30 a.m. until 9:45 a.m.	<b>Poster Presentation and Judging Humphries Hall and Ferrell-Westbrook Hall (FW), main hallway</b>
10:00 a.m. until 10:30 a.m.	<b>TAS Annual Business Meeting, Ferrell-Westbrook rm 117-119</b>
10:30 a.m. until 11:30 a.m.	<b>Welcome by TSU Leadership, followed by the Keynote speaker by Dr. Jennifer Cartwright, Science Coordinator, Southeast Climate Adaptation Science Center</b>  <b>Title: “Climate Change Impacts across Tennessee”</b>  <b>FW rm 117-119</b>
11:30 a.m. until 1:00 p.m.	<b>Lunch Break – box lunches in FW rm 117-119 or on your own</b>
1:00 p.m. until 3:30 p.m.	<b>Section Business Meetings and Oral Presentations (assigned rms)</b>
3:30 p.m. until 3:40 p.m.	<b>Judges Meeting, FW 117-119</b>
3:40 p.m. until 4:30 p.m.	<b>Student Awards Ceremony, FW 117-119</b>

## **Meet our Keynote Speaker**

Dr. Jennifer Cartwright

Southeast Climate Adaptation Science Center

Jennifer Cartwright is the Science Coordinator for the Southeast Climate Adaptation Science Center (CASC). She is an ecologist with a background in GIS and hydrology and a focus on supporting effective natural-resource management. Her research has concerned climate-change impacts on a variety of terrestrial, wetland, and freshwater ecosystems across North America. Jen has overseen studies of forest drought impacts on local-to-regional scales, modeling of wetland ecohydrology leveraging remote sensing and field observations, identification of refugia from climate change, and assessments of climate impacts to at-risk ecosystems and species. She has been affiliated with the USGS Lower Mississippi-Gulf Water Science Center since 2009 and received her Ph.D. in Biology from Tennessee State University in 2014.

### **Title: Climate change impacts across Tennessee**

The state of Tennessee encompasses many landscapes and ecosystems, from the Appalachian Mountains to the Mississippi River. Climate change and other global-change processes are likely to impact a variety of natural resources and human communities throughout the state. This keynote address will offer a virtual “tour” of the state, touching on potential climate impacts to terrestrial ecosystems such as forests and grasslands, as well as freshwater systems such as streams, reservoirs, and wetlands, plus potential impacts to agriculture and cities. Increasingly, scientific information is becoming available to help anticipate climate-change influences on a variety of processes, including drought patterns, fire regimes, geographic ranges and seasonal timing for native species, hydrologic patterns, water quality and temperature, invasive species, and pest and pathogen dynamics. This keynote address will highlight some of these scientific resources to help researchers, natural-resource managers, and Tennessee residents better anticipate and prepare for climate impacts over the years ahead.

Notations used in abstracts: (\*) student author and (#) presenting author, if not first author

## Oral Presentations

### Agriculture-1

Chair: Dr. Anthony Delmond

1:00 pm – 2:50 pm

Humphries, rm 221

1:00-1:05 Business Meeting – to be held jointly with Agriculture 2

1:05-1:20 Microbial diversity and resistance genes in small-scale goat farming system. **Ashesh Basnet\***, **Agnes Kilonzo-Nthenge**, and **Abdullah Mafiz**, *Tennessee State University, Nashville, Tennessee*. The emergence of resistance among pathogens is a major threat to animal production as well as animal and human health. The ultimate goal of this research project is to study the abundance of microbial pathogens and determine the resistance pattern from fecal samples from goats. Fecal samples were collected directly from the goat and pathogenic bacteria were isolated. Molecular confirmation of the isolated pathogens was done through Polymerase Chain Reaction (PCR). Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method. Of all samples tested, *E. coli* (94.2%) was the most prevalent followed by *S. saprophyticus* (90.5%) *S. aureus* (80.4%), *Shigella* (34.7%) and *Salmonella* (5.8%). All the isolates of *E. coli* resistant to Erythromycin and Cephalothin. High resistance was also seen in *S. aureus*, *S. saprophyticus*, *Shigella*, and *Salmonella*. Resistance from goats can transfer to the environment and humans.

1:20-1:35 The underlying effects of food insecurity in Memphis, TN. **Emmanuel Wallace\***, **Aditya Khanal**, and **Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee*. Food insecurity is a nationwide epidemic that primarily impacts communities of colors and low-income neighborhoods. Food insecurity is the state of having unreliable access to affordable and nutritious food. The national average of food insecurity is 11.8%, but in Memphis, Tennessee the average is at 13.7% and the rate of food insecure children is 27%. Residents that reside within food insecure zones often face health disparities as a result of this including hypertension, obesity, diabetes, and depression. Community gardens have been shown to be an effective solution to bridge nutritional gaps while also educating the community on where food comes from. The objectives of this research were to collect baseline information and assess the severity of the food desert problem in communities of color and low-income neighborhoods in Memphis, Tennessee. Sample survey data will be collected, collated, and analyzed to evaluate the research question identified in this project.

1:35-1:50 Allelopathic effects of extracts derived from live shoot material of the cover crops annual ryegrass, crimson clover, tillage radish, and winter wheat. **Grayson DeLay\*** and **Anthony Witcher**, *Tennessee State University, McMinnville, Tennessee*. Cover crops provide many benefits such as reduced soil erosion, increased soil organic matter, breaking up compaction, and suppressed weed growth. The study evaluated filtrates of live shoots (600g/L, 450g/L, 300g/L, 150g/L, and 0g/L as control) from annual ryegrass, crimson clover, tillage radish, and winter wheat on germination percentage and root length of annual ryegrass and tomato. Seeds were placed on extract saturated filter paper in petri dishes for 7 days. All cover crop filtrates at 600g/L decreased germination percentage of both test species except annual ryegrass on annual ryegrass seed. All cover crop filtrates at 600g/L and 450g/L decreased root length of both test species except annual ryegrass on annual ryegrass seed. These results showed a negative effect on germination and growth from cover crop filtrates at higher concentrations. Future research will test whether control was due to the high concentrations of soluble salts observed during the study.



**1:50-2:05** Plant harvest components of mung bean in Tennessee. **Joshua Relyea, Dr. Hui Li, Max Miller, Lahari Nekkhalapudi, Chelsa Randle, and Matthew W. Blair**, *Tennessee State University, Nashville, Tennessee*. As farmers, we need to cultivate vigorous high yielding plant species. With a variety of plant species available, it is crucial to choose crops that are economical and nutritional. In middle Tennessee, we plan to incorporate a different kind of crop that is newer to this region called Mung bean. Many people, especially those that are native to the United States are unaware of this ancient plant. This plant belongs to the legume family and is scientifically known as *Vigna Radiata*. This species contains high amounts of protein, iron calcium and magnesium. The focus of this experiment is to see the growth and development of this crop in the United States. Cultivating in three locations across Tennessee allows us to see the development in different regions. We are focused on yield per variety, soil microbial interaction with rhizobia along with the nutritional contents mung bean supplies based on environmental factors.

**2:02-2:20** Behavioral measures of heifer temperament and selection of docile cattle for rumen fistulation surgery. **Katrina S. Pope\*, Craig S. Darroch, and Clint A. Ary**, *University of Tennessee-Martin, Martin, Tennessee*. The study objective was to determine the best animal behavior measurements for selecting potential candidates for ruminal fistulation surgery. Five heifers were observed over 15 days to select two heifers with ideal temperaments for surgery. Dominance order, chute scores, and exit velocities were used to rank cattle temperaments. A docile heifer is preferred for surgery to minimize injury and facilitate handling. Behavioral observations were made on the heifers during surgical restraint. Post-surgery, flight zone measurements were correlated to behavioral temperament scores. A significant correlation was found between the total temperament score and chute scores used to select heifers ( $r=0.95$ ,  $p < 0.01$ ). The fistulated heifers had a significantly smaller flight zone ( $0.89 \text{ m} \pm 0.23$ ) than non-fistulated cattle ( $1.93 \text{ m} \pm 0.18$ ). In summary, behavioral temperament scores can be used to select docile cattle, and this should help minimize surgical and handling stress.

**2:20-2:35** Development and applications of kefir-based films and coatings. **Yelyzaveta Zuy\* and Keely O'Brien**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Although plastic is the most popular material used for food packaging due to its low cost and effective barrier properties, there is a growing concern about its environmental impact on the planet. Consumers are becoming increasingly more interested in using biodegradable and non-toxic packaging, while simultaneously looking for minimally processed and healthy food that still retains its shelf stability. Kefiran is a biopolymer produced by a collection of microorganisms referred to as kefir grains during milk fermentation. Unlike other polymers, which only serve as barriers between food and the outside environment, kefir displays anti-inflammatory, anti-microbial, and antioxidant characteristics. The present research focuses on development of kefir-based solid films and liquid coatings and their applications, including packaging and storage of food.

**2:35-2:50** Evaluation of flowering plants for arthropod natural enemies. **Yuna Gaire\*, Kaushalya G. Amarasekare, Firuz Yuldashev, and Sarah Kilcoyne**, *Tennessee State University, Nashville, Tennessee*. Flowering plants that attract beneficial arthropods, such as natural enemies and pollinators, are called insectary plants. The floral resources are essential for some natural enemies to survive, develop, and reproduce when the prey is scarce. Although the use of flowering plants in crop fields is not a new concept, their use is still limited to a few plant species. Information on species of insectary plants and the type of natural enemies they attract is still scarce in the southeastern US. We selected eight species of flowering plants based on USDA plant hardiness zones that match the Tennessee hardiness zones. The objective of this study is to find the suitability of various insectary plant species to use in pest management in crop production. Our results show that cosmos, sunflower, marigold, and *Rudbeckia* attract predatory arthropods, such as syrphid flies, ladybeetles, big-eyed bugs, ground beetles, and *Orius* sp. We discuss the results.

## Agriculture-2

Chair: Dr. Diana Lynn Watson

1:00 pm – 2:50 pm

Humphries, rm 222

1:00-1:05 Business Meeting – to be held jointly with Agriculture 1

1:05-1:20 Combination of PCR primer development and touchdown procedure for specific and sensitive detection of *Phytophthium vexans*. **Farhat A. Avin, Bhawana Ghimire\***, and **Fulya Baysal-Gurel**, Tennessee State University, McMinnville, Tennessee. *Phytophthium vexans* is an oomycete pathogen causing root and crown rot of woody ornamentals. A specific PCR-based detection would help in quick confirmation of this pathogen without the need for sequencing. Therefore, based on the variations in mitochondrial cytochrome oxidase subunits I and II sequences of *Phytophthium* and other oomycetes, two pairs of species-specific primers were developed (CoxI-PV1/2 and CoxII-PV1/2). After screening six different isolates of *P. vexans* and thirty species from other oomycetes and common plant pathogens, the CoxI-PV1/2 primers produced only a single band of 560 bp from *P. vexans*. The sensitivity of the primers was 640 pg per 25- $\mu$ L PCR reaction. A touchdown-PCR procedure was developed and increased the detection sensitivity to 25.6 pg per 25- $\mu$ L PCR reaction. The developed PCR-based amplification was accurate, rapid, and sensitive for the detection of *P. vexans*. Moreover, it could simplify pathogen monitoring and diagnosis and support plant disease management.

1:20-1:35 Proteomics analysis of strawberry fruits exposed to essential oils. **Kajol Pradhan\***, **Priya Thapa**, **Suping Zhou**, **Theodore Thannhauser**, **Yong Yang**, **Tara Fish**, and **Toktam Taghavi**, Tennessee State University, Nashville, Tennessee (KP, PT, SZ), USDA ARS, Ithaca, New York (ThT, YY, TF), and Virginia State University, Petersburg, Virginia (TT). This study aims to identify strawberry proteins that are responsive to surface treatments to delay or prevent fruit rot caused by fungal infection. Four strawberry varieties including Albion, Allstar, Jewel, and Sweet Charlie, were packaged inside a separate air-tight container and exposed to 30ppm concentration of five essential oils (thymol, cinnamon oil, eugenol, clove bud oil, non-enal) by placing them in cotton ball. Fungicide Switch (30ppm) and no treatment were used as positive and negative control respectively. Protein were precipitated and tryptic digested proteins were labeled using the 16-plex tandem mass tag (TMT) kit. The proteomes were identified using real time search selection and MS3 quantification. 4304 proteins were identified and proteins showing significant differences in relative protein abundance between treated and control samples were taken as differentially abundant proteins (DAPs); these DAPs were used to identify the biological processes associated with fruit rot, and plant defense against fungal infection.

1:35-1:50 Plant defense elicitor reduces ambrosia beetle attacks in flowering dogwoods exposed to simulated flood stress condition. **Madhav Parajuli\***, **Cansu Oksel**, **Krishna Neupane\***, **Christopher M. Ranger**, **Jason B. Oliver**, **Karla M. Adesso**, and **Fulya Baysal-Gurel**, Tennessee State University, McMinnville, Tennessee (MP, CO, KN, JBO, KMA, FBG), and USDA-Agricultural Research Service, Horticultural Insects Research Lab, Wooster, Ohio (CMR). Ambrosia beetles are economically important wood-boring pests of flowering dogwoods. Acibenzolar-S-methyl (ASM), a plant defense elicitor, was evaluated for effectiveness in inhibiting ambrosia beetle attacks in dogwoods exposed to simulated flood stress. Container-grown dogwood trees were assigned to ASM drench+flooding, ASM foliar+flooding, ASM drench+no flooding, ASM foliar+no flooding, no ASM+flooding, and no ASM+no flooding. The experiment was arranged in a completely randomized design with six replications. Ambrosia beetle attacks were counted every other day for 28 days. Plant tissue core samples were collected at 7 and 14 days' post flooding to determine ethanol content. Plants exposed to no ASM+flooding had the highest number of attacks, but the number of attacks was significantly reduced in plants assigned to ASM (drench or foliar)+flooding. Only the plant tissues collected from the flooded plants produced ethanol. Our results indicate ASM can induce plant defense response to ambrosia beetles in dogwoods under stress conditions.

**1:50-2:05** Field evaluation of three biological control agents for southern blight disease management and their effects on hemp plant growth. **Mustapha Olawuni, Margaret T. Mmbaga, and Daniel Demmissie**, *Tennessee State University, Nashville, Tennessee*. The production of industrial hemp faces challenges in disease management and usage of chemical pesticides requires alternative products. Endophytic microorganisms that grow inside plants without harming their hosts have a symbiotic relationship with their hosts and provide plant protection against pathogens as biological control agents (BCAs); some promote plant growth. Endophytes tend to occupy the same ecological niche as the phytopathogens and are likely to be effective alternatives to chemical pesticides. Three bacterial isolates, IMC8 (*Bacillus thuringiensis*), PRT (*Bacillus subtilis*) and PSL (*Bacillus amyloliquefaciens*) were evaluated for biological control of southern blight (*Sclerotia rolfsii*) and for plant growth promotion in a soil infested with southern blight pathogen. Laboratory bioassay showed that PSL, PRT and IMC-8 inhibited *Sclerotia rolfsii* growth. Field evaluation showed that PRT and IMC8 and a mixture of the three bacteria improved plant growth exhibited by higher dry weight; but disease suppression in field conditions was inconclusive.

**2:05-2:20** Molecular diversity and functional implication of amphibian interferon complex: remarking immune adaptation in vertebrate evolution. **Oluwaseun D. Adeyemi, Yun Tian, Collins N. Khwatenge, Leon Grayfer, and Yongming Sang**, *Tennessee State University, Nashville, Tennessee (ODA, YT, CNK, YS)*, and *George Washington University, Washington, DC (LG)*. The complex interferon (IFN) systems in amphibian species has been unraveled due to comparison of vertebrate genome amongst various species. Recent genomic curations revealed that amphibian species have evolved expanded repertoires of four types of intron-containing IFN genes, intron-less type I IFNs and intron-containing type III IFNs similar to those seen in jawed fish and amniotes respectively, including the unique intron-less type III IFNs. Based on recent reports and omics analyses using *Xenopus* models, amphibian IFN complex may possess novel functions, as indicated by their extensive molecular diversity. Here, we provide an overview and update of the present understanding of the amphibian IFN complex in the context of the evolution of vertebrate immune systems. A greater understanding of the amphibian IFN complex will grant new perspectives on the evolution of vertebrate immunity and may yield new measures to counter the global amphibian declines.

**2:20-2:35** Field evaluation of three bacterial endophytes for biocontrol of *Phytophthora capsici* and yield improvements in *Solanum lycopersicum*, Nashville, Tennessee. **Peter Eyegheleme\*, Margaret T. Mmbaga, Daniel Ambachew, and Jamille Robinson**, *Tennessee State University, Nashville, Tennessee*. Endophytes colonize plants without causing harm to their host plants. Their ability to suppress multiple plant pathogens suggests that they can offer an alternative to chemical fungicides. Endophytes occupy the same ecological niches as phytopathogens and thus have a high potential to be effective biological control agents. This study was to evaluate the efficacy of bacterial endophytes for biocontrol of *Phytophthora capsici* and yield improvement in Tomatoes. In this study, three endophytic bacterial isolates (PRT, PSL, and IMC8) were evaluated for efficacy against *Phytophthora capsici* and compared with two commercial bio fungicides, Double Nickel, Serenade and water control. PSL and Double Nickel were the best treatments on tomatoes. IMC8 was best for plant vigor and larger fruit size but a smaller number of fruits per plant on crops. This study suggests that bacterial isolates PRT and PSL can provide additional products for *P. capsici* control and improve yield in tomatoes.

**2:35-2:50** Fusaric acid analysis for conferring the resistance in different hydrangea cultivars. **Sandhya Neupane\* and Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. Fusaric acid is produced during the infection by *Fusarium oxysporum* that plays a direct role in pathogenesis. Fifteen hydrangea cultivars were either inoculated or non-inoculated with *F. oxysporum*, analyzed for root rot severity and fusaric acid recovery from roots after 4 months. Roots were homogenized in juice extractor, suspension was centrifuged, and supernatant pH was adjusted to 2.5. The supernatant was extracted with methylene chloride, by evaporating on a rotary evaporator, residue was redissolved in MeOH and stored at -20 °C. HPLC analysis was done using C18 column and elution was done using a mobile phase (20% methanol + 48% filtered HPLC grade water + 32% H3PO4 (0.43%)) for 15 min with a UV detector at 228 nm. Cultivars such as Nikko Blue, Pee Wee(p) and Frosty showed the lowest root rot severity and fusaric acid recovery in both trials showing moderate resistance to *F. oxysporum* compared to other cultivars.

**Botany and Cell & Molecular Biology**  
**Chairs: Emily Powell & Dr. Felicity Sterling**  
**1:00 pm – 3:20 pm**  
**AITC auditorium**

**1:00-1:05** Business Meeting – two section meetings to be held

**1:05-1:20** Application of cryopreservation and size fractionalization for sorghum microspores. **Trinity Gourdin, Aron Felts, Dr. Ahmad Aziz**, *Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, Tennessee*. Sorghum crop grows primarily in hot climates, and has multiple benefits such as; fodder, grain, and syrup production, while being adaptable to limited resource farming lands. The five varieties, (Achi Turi, Dale, Dasht Local, Topper 76-6, and Tx 430), were maintained under Tennessee State University's farm for genetic studies through microspores. Cryopreservation, which is a process of cooling and preserving cells, was also used to ensure year-long maintenance and viability of microspores. Procedures to isolate, freeze, and then unfreeze the immature pollen were used to observe the cell viability at each step. With certain mixtures, it was easier to conduct cryopreservation along with using "Mr. Frosty" to slowly freeze the cells. The next approach will be the fractionalization of microspores isolated from anthers, to separate these cells using density gradients. These important protocols will facilitate mass isolated sorghum microspores to be used per being responsive to androgenic media.

**1:20-1:35** Sugar gradient-based fractionalization of sweet sorghum microspores towards androgenesis. **Aron Felts\*, Trinity Gourdin, A. N. Aziz**, *Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, Tennessee*. Sweet sorghum resurgence as a renewable energy crop mandates a pathway to improve its fermentable sugar traits. One approach is through androgenesis which uses stressed immature microspores to switch from being developed mature pollen into embryogenic calli instead. This process requires mass isolated microspores that can only be harvested during a short flowering period every season. Thus, a cell fractionalization was used developed to isolate various developmental stages of microspores through using Percoll density gradients and cryopreserving each accordingly. Anthers were aseptically dissected from spikelets and crushed in 0.1 molarity mannitol through mortar and pestle to yield concentrated microspores by centrifugation for five minutes at 450g after slow start. To create isotonic solutions, 1.0 molarity mannitol was used for 55/45/35% sugar gradients towards separation per five developing stages of free microspores. Such isolated microspores can be used for androgenesis to create sweet sorghum plantlets with enhanced sugar related traits.

**1:35-1:50** CAPE peptides are involved in nitrogen acquisition and nodulation in *Medicago truncatula*. **Divya Jain\* and Sonali Roy**, *Tennessee State University, Nashville, Tennessee*. Nitrogen is one of the major limiting nutrients in plant productivity. The study of root uptake mechanisms for macronutrients like nitrogen is vital to our understanding of their role in plant growth and development. Small signaling peptides (SSPs) are hormones that regulate diverse plant developmental processes. However, their involvement in the regulation of nutrient uptake by roots is poorly understood. Exogenous application of the synthetic CAPE (CAP-derived peptide) Nitrogen Responsive CAP-derived Peptide (MtNRCP) in the model legume *Medicago truncatula* reduced production of lateral roots by 50-60% and increased root hair length by more than 25% suggesting MtNRCP is involved in nitrogen foraging response. Experiments examining MtNRCP's role in nodulation are currently underway. Our findings indicate a role for CAPE peptides in maintaining plant nutrient homeostasis. This study will help uncover novel functions of SSPs and contribute towards their possible application in improving nitrogen use efficiency in agriculture.

**1:50-2:05** An update on the vascular flora known from Land Between The Lakes National Recreation Area, Kentucky and Tennessee. **Edward W. Chester**, *Austin Peay State University, Clarksville, Tennessee*. This report gives results of floristic studies in Land Between The Lakes National Recreation Area (LBL) since 1964 and updates three previous checklists. This fourth checklist includes 1408 taxa and designates introduced and listed elements. LBL comprises 170,000 acres in southwestern Kentucky and northwestern Tennessee between impoundments of the lower Tennessee River (Kentucky Reservoir)

and lower Cumberland River (Barkley Reservoir). The area is mostly upland forests with 300 miles of reservoir shoreline. Established in 1964, the Tennessee Valley Authority was granted stewardship with the mandate to develop a National Demonstration area for conservation, education, and recreation. The U.S. Forest Service assumed control in 1999, continuing the mandate; there are numerous facilities to meet the mandated objectives. Prior to 1964, the area consisted of farms, scattered communities, and a National Wildlife Refuge, all relocated. Studies continue.

**2:05-2:20** Taxonomic, conservation, ecological, and morphological analysis of 4,553 plant species of the interior Southeast US. **Sevyn Brothers\* and Joey Shaw**, *University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Tennessee and Kentucky are centrally positioned in the interior Southeastern US and combined they contain ~3600 vascular plant species and lesser taxa. There are ~1,000 other species across a wider area of the interior Southeast. Launched in 2021, the Tennessee-Kentucky Plant Atlas (TNKY) has become a major resource for botanists and conservation workers in the region. Underlying TNKY is a database of taxonomic, conservation, ecological, and morphological characters for 4553 species and lesser taxa. While a work in progress, here we report on characteristics of the flora of the interior Southeast, which is represented by 214 families, 1024 genera, and 4553 species. Eighty percent of the flora is native and over 200 species are listed invasive by at least one southeastern state. Fifty-eight percent are forbs, 19% are graminoids, 18.6% are woody with 463 shrubs and 313 trees. The TNKY database consists of >100 other characteristics of the flora.

**2:20-2:35** Assessing the usefulness of botanical illustration in the *Guide to the Vascular Plants of Tennessee*. **Catherine R. McGuigan\*, Andi Kur, and Joey Shaw**, *University of Tennessee at Chattanooga, Chattanooga, Tennessee*. From the beginning of science, botanical illustration has been used as a way to convey critical aspects within the field of botany. Currently, the *Guide to the Vascular Plants of Tennessee* includes 626 glossary terms, 141 of which have illustrations. Of the 141 illustrations, 49% depict leaf morphology, 8% stem, 24% floral, 11% inflorescence type, and 8% fruits. All illustrations are confined to nine pages of plates in the front of the book, leaving difficult key couplets and family characteristics for the reader to interpret from written text only. The goals for the Second Edition are to create a more robust series of front plate illustrations that are more closely tied to the glossary, provide illustrations for technically-challenging points throughout the text, and to provide illustrations for families that have unique characteristics and terminology. Here we report our progress, which to date has focused on glossary-based terms and family-level characteristics.

**2:35-2:50** Progress toward the second edition of the *Guide to the Vascular Plants of Tennessee*. **Joey Shaw**, *University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Two comprehensive floristic works for Tennessee have served as compendia of the state's vascular plants, Gattinger's (1901) *The Flora of Tennessee and Philosophy of Botany* and the Tennessee Flora Committee's (2014) *Guide to the Vascular Plants of Tennessee*. The former was an overview of the vegetation and an annotated checklist with representative site locations. The latter was built on an additional century of research and included sections on the physical environment, history of botany, overview of vegetation, floristic summary, and keys to families, genera, and species. Following publication of the *Guide* herbarium specimen digitization efforts increased access to hundreds of thousands of herbarium specimens. Additionally, because the *Guide* was a definitive resource, workers were more easily able to recognize species known from Tennessee or science and those that were not. Recent scientific advancements have further led to numerous scientific name changes. Progress toward a 2024 Second Edition, is reported here.

**2:50-3:05** Influence of citric acid on the boron adsorption on oxide minerals: A macroscopic and in situ ATR-FTIR study. **Avedananda Ray\*, Sudipta Rakshit, Jerzy Mierzwa, and Dafeng Hui**, *Tennessee State University, Nashville, Tennessee*. Citric acid is a major organic ligand ubiquitously present in the soil. The presence of citric acid may influence the metal chelation and availability of plant micronutrients (such as Boron) through competitive retention mechanisms on soils. Here we propose to investigate the competitive retention mechanism of boron (B) and citric acid on iron oxide minerals (Hematite) using macroscopic sorption studies, and in situ ATR-FTIR spectroscopic probes to understand the surface interaction mechanisms under a range of solution properties. Preliminary results suggested that hematite have higher affinity for citric acid and B retention on hematite was influenced in the presence of citric

acid. In situ ATR-FTIR results revealed the change of surface complexation mechanism of Boron in the presence of citrate.

**3:05-3:20** Isoform-specific role of Glycogen Synthase Kinase-3 in obesity-induced glucose intolerance. **Jacob J. Lemon\***, **Prachi Umbarkar**, **Sultan Tousif**, **Manisha Gupte**, and **Hind Lal**, *Austin Peay State University, Clarksville, Tennessee (JLL, MG), and University of Alabama, Birmingham, Alabama (PU, ST, HL)*. Obesity-associated metabolic disorders are rising at pandemic proportions; hence, there is an urgent need to identify underlying molecular mechanisms as potential therapeutic targets against obesity-associated perturbations. Glycogen Synthase Kinase-3 (GSK-3), an enzyme with two isoforms (GSK-3 $\alpha/\beta$ ), is highly implicated in metabolic diseases, including obesity-induced glucose intolerance. In the present study, we investigated the isoform-specific role of GSK-3s in glucose metabolism in high-fat diet-induced obesity. Control and GSK-3 $\alpha$ /GSK-3 $\beta$  heterozygous mice were fed a high-fat diet for sixteen weeks. After four weeks of high-fat feeding, GSK-3 $\beta$  inhibition improved glucose clearance in GSK-3 $\beta$  heterozygous mice, but chronic high-fat feeding blunted this protective effect when GSK-3 $\beta$  heterozygous mice gained significantly higher body weight (fat mass) compared to the controls. In contrast, GSK-3 $\alpha$  inhibition did not affect glucose clearance. These results suggest that GSK-3 $\beta$  is the dominant isoform in glucose regulation in obesity-induced glucose intolerance and nutritionally regulated by high-fat feeding in a weight-dependent manner.

## Chemistry

Chair: **Dr. Xuanzhi Zhan**

**1:00 pm – 3:50 pm**

**Humphries, rm 203**

**1:00-1:05** Business Meeting

**1:05-1:20** Computational analysis of novel inhibitors of dihydrofolate reductase in three bacterial species. **Allison Adams\***, **Derek Cashman**, *Tennessee Technological University, Cookeville, Tennessee*. The aims of this project are the design of high affinity small molecule inhibitors of bacterial dihydrofolate reductase for the purpose of obtaining broad-spectrum antibiotics for *Bacillus anthracis*, *Staphylococcus aureus*, and *Mycobacterium tuberculosis*. Inhibitors were designed using the MOE 2020 to target the active site of DHFR based on computational analysis of the energetic frustration for determining areas of the molecule in high energetic states and evolutionary importance of amino acid residues for determining binding specificity present to determine the active site via the Protein Frustratometer and Evolutionary Trace. 388 organic molecules were designed to interact with these amino acids via complementary, non-covalent functional group interactions. These compounds were assessed according to Lipinski's Rule of 5, Gram-Negative eNTRY Rules, and ligand-based and receptor-based pharmacophores. Nine of the best compounds were analyzed through molecular dynamics simulations using NAMD v.2.9 and analyzed via VMD in order to verify and refine these results.

**1:20-1:35** Computational design and docking of Hamigeromycin B natural product derivatives in 26 human kinases. **Meagan Edmonds\***, **Derek Cashman**, **Jesse Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Hamigeromycin B analogs are synthetic natural product derivatives with potential for mediating signal transduction in human kinases. The potential biological activity of proteins was studied by computational methods. The goal is to develop potential cancer drugs based on Hamigeromycin B emphasizing ease of synthesis, cost-effectiveness, and specificity. 11 analogs were constructed using MOE 2020 and optimized using AMBER14:EHT. These compounds were docked into 26 human kinases in the Protein Data Bank. The docking sites in each kinase were targeted using the Protein Frustratometer and Evolutionary Trace to characterize the energetics and evolutionary importance of amino acids for contributions to binding. The lowest binding scores were used to determine the best binding and orientation of each analog. Three kinases were screened with a set of resorcylic acid lactones from a literature search and modified from Hamigeromycin B. Pharmacophore modeling

was utilized to screen key features in all analogs. The pharmacophore study identified the best analogs with the strongest binding affinity to JNK3, HSP90, and EGFR.

**1:35-1:50** Derivatization methods for Perfluoroalkyl Substances (PFAS) by gas chromatography/tandem mass spectrometry (GC-MS/MS). **Clement Aruada\***, **Andrew Callender**, *Tennessee Technological University, Cookeville TN*. Perfluoroalkyl substances (PFAS) are environmentally persistent, and potentially harmful. These “forever chemicals” are widely distributed across the globe, and methods are needed for the rapid and routine analysis in a variety of matrices. Gas chromatography with mass spectrometry (GC/MS) is commonly used for the analysis of water samples, but PFAS pose special problems in sample pretreatment, separation, and detection. Here, we present a sensitive, simple, and reliable analytical technique for the determination of perfluorocarboxylic acids (PFCAs) by GC-MS/MS. We compare the performance of two derivatization methods – esterification with isobutyl chloroformate (IBCF) and amidation with 2,4-difluoroaniline (DFA) - and report optimized conditions for the derivatization reactions, as well as their GC retention properties and characteristic MS fragments. The instrument detection limit is determined from a calibration curve study, and found to be acceptable for the analysis of surface water samples following appropriate enrichment by dispersive liquid-liquid microextraction (DLLME) and derivatization.

**1:50-2:05** Forensic identification of textile dyes and fiber composition on a single strand of sub-milligram fiber using Raman techniques coupled with microwave-assisted extraction. **Bilquis Y. Bintinlaiye\***, **Beng G. Ooi**, and **Ngee S. Chong**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Improving the reliability of methods for fiber analysis is crucial towards the ability of forensic examiners to establish the association of a perpetrator with a crime scene or a victim. The use of Raman spectroscopy has been demonstrated in forensic fiber analysis for the identification of dyes and polymeric materials in fibers collected at crime scenes. In this study, the imaging capability of Raman microscopy, experimental conditions, and analytical sensitivity of surface enhance Raman scattering (SERS) were investigated for their influence on the discriminating power of the Raman technique for the identification of textile fibers on the basis of its polymeric composition and dyes. A novel approach based on microwave-assisted extraction of sub-milligram samples with colloidal silver solution followed by SERS analysis are found to be suitable for dye identification.

**2:05-2:20** Measurement of ammonia and methane using FTIR spectroscopy. **Sarah Bom-Crocker\***, **Ngee Chong**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Ammonia and methane measurements in air samples are often required and regulated by organizations such as the Occupational Safety and Health Administration and the Environmental Protection Agency. Both compounds have relatively low odor thresholds and potential adverse health effects for exposure at high concentrations. The goal of this project is to develop methods based on Fourier Transform infrared (FTIR) spectroscopy using gas cells. Although methane can be measured directly, ammonia is sampled as ammonium sulfate on H<sub>2</sub>SO<sub>4</sub>-treated glass wool followed by conversion to NH<sub>3</sub> via NaOH reaction with ammonium sulfate. Gas cells with optical pathlengths of 10 cm and 10 m are used to evaluate the practical concentration ranges of ammonia measurement. Different analytical schemes for the conversion and measurement of ammonia are explored to achieve low detection limits while overcoming the strong adsorption effects of ammonia that gives rise to memory effects observed between successive analyses.

**2:20-2:35** Investigation of americium/europium separation using 3,3'-dibutyloxy-phen-bis-1,2,4-triazinyl-2,6-pyridine. **Lesta S Fletcher\***, **Mariah L Tedder\***, **Fortune O Dzeagu\***, **Dale D Ensor**, **Jesse D Carrick**, *Tennessee Tech University, Cookeville, Tennessee*. The synthesis of an effective ligand for the extraction of minor actinides (i.e. Am(III)) from spent nuclear fuel remains a significant research focus. Effective ligands should be stable under acidic conditions, soluble in a range of diluents, and provide fast phase-transfer kinetics. In this presentation, preliminary results regarding the performance of a newly synthesized ligand, 3,3'-dibutyloxy-BTP, for the separation of americium from europium are described. Comparison of distribution values under various conditions including ligand and acid concentration, diluent, and contact time will be presented. Complexation chemistry of 3,3'-dibutyloxy BTP with selected trivalent lanthanides from spectrophotometric titrations will also be disseminated.

**2:35-2:50** Optimization of conditions for extracting cannabinoids using microwave and ultrasonication. **Joshua B. Animasaun\***, **Beng Guat Ooi**, and **Ngee Sing Chong**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Cannabinoid compounds extracted from *Cannabis sativa* have demonstrated high therapeutic potential. Hence, efficient extraction together with reliable determination of these compounds is crucial for utilization of hemp abstract. In this research, optimal extraction conditions for hemp samples were developed, which involves the comparison of ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE) using ethanol as a solvent. In this study, comparison of the percent yields of cannabinoid compounds between cannabis flower and cannabis stem were also examined. GC-MS analysis shows that cannabis bud contains more cannabinoid compounds with the amount of CBD present in the cannabis bud five times greater than that of cannabis stem. The changes in the cannabinoid profile of cannabis extracts are related to the conditions of extraction temperature and extraction time. The decarboxylation of the carboxylic acid functional group among some cannabinoid compounds are evaluated by using GC-MS as the post-extraction analytical technique.

**2:50-3:05** Oxidative condensation strategy for the direct synthesis of heteroaryl carbonitriles using a hypervalent iodine/NH<sub>4</sub>OAc reagents. **Eric A. Agyei\***, **Jesse D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Current work in this laboratory continues to center on the synthesis of soft-Lewis basic complexant motifs for possible use in chemoselective liquid-liquid separations of trivalent actinides from lanthanides in used nuclear fuel. In this study, an oxidative condensation approach using the hypervalent iodine reagent, *bis(acetoxy)iodobenzene (BAIB)*, as the oxidant, together with NH<sub>4</sub>OAc as the nitrogen source afforded the direct synthesis of heteroaryl carbonitriles from the corresponding carbaldehydes in good to high yields. These advanced carbonitriles can subsequently be used to produce unsymmetric *bis-1,2,4-triazinyl pyridine (BTP)* scaffolds via telescoped condensation techniques previously reported by our lab. Access to these unsymmetric BTPs will provide the ability for further separations studies from simulated spent nuclear fuels. Synthetic-method development and optimization, relevant substrate scope, and a scale-up reaction of these essential materials will be presented.

**3:05-3:20** Synthesis of heteroaryl 1,2,3-triazoles via an intermolecular cyclization method mediated by DBU. **Orume Junior Edirin\***, **Jesse D. Carrick**, *Tennessee Tech University, Cookeville, Tennessee*. Chemoselective isolation of the minor actinides from the lanthanides is a crucial step in the closure of the nuclear fuel cycle. The desired results in liquid-liquid separations can be facilitated by complexants that impact covalent orbital interactions with essential additives of interest, allowing access to additional transmutative processes that could reduce issues with the storage of spent nuclear fuel (SNF) created during the process of energy and weapons production. In this work, N-tosylhydrazones were successfully produced in high yields via a thermally induced intermolecular reaction between formyl mono-1,2,4-triazin-3-yl pyridine and 4-methylbenzenesulfonylhydrazides. 1,8-diazabicyclo[5.4.0]undec-7-ene-mediated cycloaddition of N-tosylhydrazones led to the synthesis of pyridyl [1,2,3]-triazoles in high yields. Reverse-phase chromatography method was used to isolate the end product. Functional group formation of requisite starting materials, substrate scope, development of a reverse-phase automated flash purification technique will be presented.

**3:20-3:35** The structure of N-terminal of JNK3 predictions and its binding calculations with upstream kinases using In Silico prediction methods. **Timothy C. Bryant\***, **Xuanzhi Zhan**, **Derek J. Cashman**, *Department of Chemistry, Tennessee Technological University, Cookeville, Tennessee 38505*. Recent examinations of c-Jun amino-terminal kinase 3 (JNK3) have shown that proper binding and activation of the protein is dependent on the presence of the N-terminus, only found in the JNK3 isoforms. As such, the N-terminus of JNK3 presents an exceptional opportunity for medicinal targeting as a potential isoform specific inhibitor. In order to examine possible binding sites of the N-terminus, modified 3-dimensional structures were constructed from incomplete PDB structures. Once constructed, docking calculations were performed using ClusPro. Three residues, Met1, Glu11, and Lys17, were consistently present, while other residues varied based on which of the binding partners used. These results suggest that an inhibitor targeting Met1, Glu11, and Lys17 may be useful and specific to JNK3.

**3:35-3:50** From Benzonitrile to Dicyanobenzenes: The effect of an additional CN group on thermochemistry and negative ion photoelectron spectra of dicyanobenzene radical anions, **Kie T. Workman\***, **Rebecca A. Firth** and **Wilson K. Gichuhi**, *Department of Chemistry and Department of*



*Chemical Engineering, Tennessee Technological University, Cookeville, Tennessee 38505.* The negative ion photoelectron spectra (NIPES) of 1,2 dicyanobenzene (o-DCNB), 1,3 dicyanobenzene (m-DCNB), and 1,4 dicyanobenzene (p-DCNB) radical anions (DCNB<sup>•-</sup>), acquired through the computation of Frack-Condon (FC) factors are presented. The FC calculations utilize harmonic frequencies and normal mode vectors derived from density functional theory (DFT) at B3LYP/aug-cc-pVDZ basis set. All the totally-symmetric vibrational modes are treated with Duschinsky rotations to yield neutral DCNBs in their singlet (So) and lowest triplet (T1) states, following an electron removal from the doublet anionic ground state. Vibrational analysis reveals evidence of FC activity involving ring distortion, C-N bending, and ring C=C stretching vibrations in both the So and T1 states. With the detection of cyanonaphthalene (C<sub>10</sub>H<sub>7</sub>CN) and cyanoindene (C<sub>9</sub>H<sub>7</sub>CN) in the interstellar medium (ISM), our results highlight the extent to which replacing a hydrogen on an aromatic molecule with a cyano group, C≡N, can alter the vibrational structure of the molecule/radical anion.

## **Ecology & Environmental Science - 1**

**Chair: Dr. Stanton G. Belford**

**1:00 pm – 2:50pm**

**Lawson, rm 109-110**

**1:00-1:05** Business Meeting; meets jointly with Ecology & Environmental Science - 2

**1:05-1:20** Comparison of survival rates from two field seasons of reintroduced zoo-raised Eastern Hellbenders. **Marley E. Machara\***, **Sherri Doro-Reinsch**, **Dale McGinnity**, **Rebecca Hardman**, **Michael Freake**, **Brian Flock**, and **William Sutton**, *Tennessee State University, Nashville, Tennessee (MEM,WS)*, *Lee University, Cleveland Tennessee (MF)*, *Tennessee Wildlife Resources Agency, Nashville, Tennessee (BF)*, *Nashville Zoo at Grassmere, Nashville, Tennessee (SDR,DM)*, *Florida Fish and Wildlife Conservation*. Hellbender (*Cryptobranchus a. alleganiensis*) populations have declined considerably, especially in stream habitats within the Interior Plateau ecoregion. Our study evaluated the potential of captive re-introductions to bolster declining populations over the course of two field seasons. During June and July 2021, we released 6 year-old, zoo-raised hellbenders (N=29). During May 2022 we released 4 and 6 year-old hellbenders (N=33). We used a combination of radiotelemetry and PIT-tag technology to assess hellbender movements, habitat use, and survival. We hypothesized that 2022's release would have greater survival rates than 2021, as the 2022 release animals were exposed to earlier environmental conditioning. After analysis we found that the survival rate for all the 2022 cohorts was higher than the 2021 cohorts. These results suggest exposure to release conditions such as local water and food items early during conditioning, as well as earlier release dates, is key to the success of released captive-reared animals.

**1:20-1:35** An investigation of mesopredator associations in western Tennessee using long-term scent-station data. **Colten T. Snyder\***, **Benjamin F. Melton\***, **Edward L. Warr\***, and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. Long-term scent-station data collected in western Tennessee was utilized to determine the interspecific associations of seven native mammalian mesopredators. Scent-stations were monitored at the Milan Army Ammunition Plant (Gibson and Carroll counties) during summer months from 2000-2007, with additional surveys completed in 2013 and 2021. The study resulted in 10 years of data and 1,010 scent-station nights. In total, 683 visitations were recorded, with raccoon (*Procyon lotor*; n=279), Virginia opossum (*Didelphis virginiana*; n=180), and coyote (*Canis latrans*; n=114) accounting for most visitations. Chi-square tests and association coefficients were calculated to determine if visitation frequency was positively or negatively associated between species. Results indicated raccoon visitation to be negatively associated with coyote and striped skunk (*Mephitis mephitis*) visitation at stations.

**1:35-1:50** The role of pollinator visitation rates in the reproductive success of an invasive and native thistle (genus *Cirsium*). **Gabriella LeFevre\***, and **Evan M Rehm**, *Austin Peay State University, Clarksville, Tennessee*. In a changing world, native plant communities can be vulnerable to invasion when reproductive success of natives is outpaced by invasives. Variable reproductive success between closely related native and invasive species can be accentuated by impacts of changing pollinator communities in human-modified landscapes. We tested reproductive success of the invasive thistle, *Cirsium vulgare*, to a co-occurring native thistle, *Cirsium discolor*, under different pollinator communities (complete pollinator exclusion, exclusion of large bodied-pollinators, control). Complete pollinator exclusion did not result in higher probability of total flower failure in the invasive thistle; however, if a flower does not fail, excluding at least some pollinators results in lower germination success relative to the control. High levels of self-pollination may allow the invasive thistle to maintain reproductive success even when pollinators are excluded. To predict for biological invasions, we must examine relationships between reproductive biology, native/invasive status, and pollinator communities.

**1:50-2:05** Observations on biodiversity and chemical parameter tests on the Lebanon High School campus stream: Can our stream support *Ambystoma barbouri*? **Ty Drake\***, **Rebecca Dyal\***, **Erin Gallatin\***, **Josh Lamer\***, **Emily Lawson\***, **Maritza Mota\***, **Farid Saldivar\***, **Kimberly G. Atwood**, **David Ian Withers**, and **Brian Chomicki**, *Lebanon High School, Lebanon, Tennessee (TD, RD, EG, JL, EL, MM, FS, KGA)*, *Tennessee Department of Environment & Conservation, Nashville, Tennessee (DIW)*, and *City of Lebanon Stormwater Department, Lebanon, Tennessee (BC)*. The endangered *Ambystoma barbouri* (streamside salamander) inhabits intermittent streams in Indiana, Ohio, Kentucky, Tennessee, and West Virginia. In this study, chemical parameter tests and observations are being collected as baseline data for the LHS stream to help detect the presence of the streamside salamander. Previous research of similar streams suggests that the salamander species could inhabit the LHS stream; therefore, observations on the biodiversity and chemical parameter tests are still ongoing. Past data was collected on various days throughout the spring and fall; however, only one sample has been collected during the salamanders' reproductive months: December to April. Although this is a new study, and there are no confirmed sightings of the streamside salamander, this research provides baseline data for the species that inhabit this location.

**2:05-2:20** Farmer participation and interest in soil health management practices and training. **Sharla Scantling\*** and **Jason de Koff**, *Tennessee State University, Nashville, Tennessee*. Soil health and management practices that affect soil health are an important part of environmental sustainability. Farmers and agriculture play an important role in this area by engaging in activities that can enhance soil carbon, reduce erosion and greenhouse gas emissions, and enhance soil microbiota. A survey was developed to identify the current interest, perceptions, and needs for soil health by new and beginning farmers enrolled in the TSU New Farmer Academy. Results of the survey and overall conclusions will be presented.

**2:20-2:35** Understanding surface complexation mechanisms of small nucleotides on iron oxide minerals. **Diptesh Banerjee\***, **Sudipta Rakshit**, and **M.E. Essington**, *Tennessee State University, Nashville, Tennessee (DB, SR)*, and *University of Tennessee, Knoxville, Tennessee (ME)*. Nucleic acids and components are important sources of organic phosphorus (Po), which often undergo enzymatic degradation in the soil environment to the plant available inorganic P (Pi). However, this enzymatic degradation is hindered when Po is adsorbed on soil minerals. Thus, understanding the surface interaction mechanisms of Po with soil minerals is essential to predict the plant available Pi. Here we propose to study the adsorption mechanisms of a representative nucleic acid component, adenosine-5'-monophosphate (AMP), on iron oxide mineral, hematite. Our earlier study indicated that AMP has high sorption affinity for hematite; however, the specific mode of surface complexation was not reported. We evaluated the effects of ionic strengths on the adsorption of AMP on hematite at pH values ranged from 4 to 10 using both macroscopic and spectroscopic (in situ ATR-FTIR) experiments. Experiments are ongoing and the preliminary results confirmed the inner-sphere nature of the bonding via P- moiety.

**2:35-2:50** Incorporating species susceptibilities and climate change into models of *Batrachochytrium salamandivorans* risk in the United States of America. **Matthew Grisnik**, **Matthew J Gray**, **Jonah Piovio-Scott**, **Edward Davis Carter**, and **William B Sutton**, *Tennessee State University, Nashville, Tennessee*

(MG, WBS), University of Tennessee, Knoxville, Tennessee (MJG, EDC), and Washington State University, Vancouver, Washington (JPS). Worldwide, amphibians are threatened by factors including climate change and emerging pathogens. One pathogen, *Batrachochytrium salamandivorans* (Bsal) has caused die-offs of European salamanders, representing a conservation concern for the United States of America (U.S.A.), the hotspot of salamander diversity. Despite not having been detected, previous work has predicted the risk of Bsal emergence in the U.S.A., however including more data can improve these models. The objective of this work was to incorporate species-specific responses and climate change to predict Bsal emergence in the U.S.A. To generate this prediction, we used geospatial data representing introduction risks, species susceptibility, and climatic suitability. Across climate scenarios, our models predicted the greatest risk of Bsal emergence in the Southeastern and Northwestern U.S.A., with the highest climatic suitability for Bsal in the Northwest, and most susceptible species in the Southeast. Under future climatic scenarios, we found that the climatic niche of Bsal was greatly reduced.

## **Ecology & Environmental Science - 2**

**Chair: Dr. William Sutton**

**1:00 pm – 2:35pm**

**Lawson, rm 111**

**1:00-1:05** Business Meeting; meets jointly with Ecology & Environmental Science - 1

**1:05-1:20** The effects of pyrophytic pine forest restoration on herpetofaunal community assemblages in Bankhead National Forest, Alabama. **Rachel Brubaker\***, **William B. Sutton**, and **Allison Cochran**, *Tennessee State University, Nashville, Tennessee (RB, WBS)*, and *US Forest Service, Alabama (AC)*. The US Forest Service is restoring *Pinus palustris* stands in the William B. Bankhead National Forest (BNF) located within the northern terminus of the historic *P. palustris* distribution. This study investigates the effects of four distinct forest structural stages of *P. palustris* restoration on herpetofaunal community assemblages. We sampled herpetofaunal communities within 16 forest stands using passive drift fence trap arrays for 1804 trap nights throughout summer 2021 and 2022. We captured over 2400 individuals comprising 45 species of herpetofauna. We compared species assemblages within restoration stages using nonmetric multidimensional scaling and developed habitat models for individual species using a mixed models approach. This research investigates the relationship between forest structure and disturbance on species richness within the northern terminus of *P. palustris* forests. This study will assist managers in future forest management decisions, expand species records of Alabama herpetofauna, and clarify effects of forest restoration on herpetofaunal communities.

**1:20-1:35** Effects of mycorrhizal network on overstory tree growth in southeastern forests. **Rebekah Long\*** and **Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee*. Maples and trees associated with arbuscular mycorrhizal (AM) fungi are increasing in population while ectomycorrhizal (EM) associated tree species, such as ecologically critical oaks are declining in populations. This composition shift could be a consequence of poor forestry management systems. Despite considerable research on mycorrhiza and sapling establishment, there is limited research on mycorrhizal effects on overstory tree growth. To understand impacts of different forestry managements on trees and fungal associates, we intend to collect 12-15 tree cores from four populations under contrasting management systems to be analyzed with WinDendro software. Additionally, 3 soil/root samples per core will be collected and analyzed for mycorrhizal identification using FTIR Spectroscopy. We hypothesize that (1) annual tree-ring growth of EM associated species will be greater in un-even aged forests than in forests regenerated from clear-cut silviculture; (2) there will be greater EM abundance in natural stands than in forests restored from clear-cut silviculture.

**1:35-1:50** Long-term biodiversity of small mammals captured at the Milan Army Ammunition Plant in Tennessee. **Benjamin F. Melton\***, **Colten T. Snyder\***, **Edward L. Warr\***, and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. Small mammal populations at the Milan Army Ammunition

Plant in western Tennessee were assessed to determine long-term biodiversity of the site. From 1999-2022, 3,234 small mammals were captured, and morphologic characteristics were recorded. The most abundant species taken was the white-footed deer mouse (*Peromyscus leucopus*) with 1,906 captures, which account for 58.9% of the total animals captured. The second most captured species was the hispid cotton rat (*Sigmodon hispidus*) with 852 captures accounting for 26.3% of the total animals captured. Other species were caught much less frequently and made up the remaining captured animals. Catch per unit effort, biodiversity, and species evenness consistently fluctuated throughout the study period. However, species richness showed a sharp decline in 2021. These metrics show that no additional management efforts are needed at this time. However, the area should continue to be monitored for future changes in biodiversity.

**1:50-2:05** You're stressing me out: Native tree response to extreme heat. **Joseph Endris\* and Evan Rehm**, *Austin Peay State University, Clarksville, Tennessee*. Accelerating climate change will place additional pressure on hardwood trees through atmospheric warming. Additionally, exposed leaves experience surface temperatures above ambient air temperature. Tree species with an insufficient safety margin of heat tolerance may experience stress or reduced photosynthetic performance during current and future heat waves. We examined 11 hardwood tree species present on the Austin Peay woodlot. The species were selected to include varying successional traits. Results indicate that 3 of 12 species exhibit heat stress at temperatures ~44°C, which is in line with current high temperature. Conversely, 3 of 12 species show no stress until 48°C, giving these species a significant buffer against current and future extreme heat events. Species with smaller thermal safety margins are likely already experiencing heat related stress which will be further exacerbated under continued atmospheric warming.

**2:05-2:20** Optimization of flatheaded borer traps through evaluation of shape, type, and effective lure components. **Asmita Gautam\*, Joshua P. Basham, Paul O'Neal, Jason B. Oliver, and Karla M. Adesso**, *Otis L Floyd Nursery Research Center, Tennessee State University, McMinnville, Tennessee*. Flatheaded borer (*Chrysobothris* spp.) is a common woodboring beetle distributed throughout the United States. Many wood-boring beetles use color as visual cue to locate hosts and potential mates. Three experiments were conducted in the summer of 2022 to evaluate the effectiveness of purple traps for the development of improved *Chrysobothris* monitoring tools. In the first test, purple pole traps were baited with volatiles ((E)-2-hexenyl acetate and (Z)-3-hexanol alone and in combination). In the second test, two different trap types were set up in a trap array (4 purple Lindgren funnels vs. 4 purple pole traps). In the third test, purple Lindgren funnel traps were tested at different heights: ground level (1.5 m) and in the tree canopy (15 m). Borers were collected from traps bi-weekly from May through August. The response of beetle genera to the different tests was assessed to determine whether any of the treatments improved trap capture.

**2:20-2:35** Effects of polyatomic anions on antimony adsorption on hematite. **Jerzy Mierzwa and Sudipta Rakshit**, *Tennessee State University, Nashville, Tennessee*. Antimony and its inorganic compounds are classified by the EPA to the group of "emerging contaminants". In the environment, antimony exists mainly as Sb (III) and Sb (V). The most stable oxidation state of antimony in the environment is Sb (V). Hematite is a very common iron (III) oxide mineral, and it may act as a sink of some metallic pollutants. We earlier reported surface complexation modeling of Sb (V) on hematite surface. Various macroscopic and spectroscopic experiments were carried out to understand the effects of solution properties for antimony (V) sorption on hematite. In this recent study, a competitive sorption of Sb (V) and some polyatomic anions (phosphate, sulfate, and bicarbonate) was studied to evaluate the effect of these anions on the adsorption and the surface complexation mechanism. It will be shown that the presence of the above anions has an influence on the adsorption of antimony (V) onto hematite.

## Engineering & Engineering Technology

Chair: Dr. Khalid Tantawi

1:00 pm – 2:50 pm

Lawson rm 112

**1:00-1:05** Business Meeting

**1:05-1:20** Cost reduction and continuous improvement in a tire manufacturing process. **Edwin Calabrese\***, **Curtis Cross\***, **Joel Romero\***, **Rhyan Sinclair\*** and **Jody Lee Alberd**, *Austin Peay State University, Clarksville, Tennessee*. In the case of Hankook Tire Manufacturing, there is a considerable amount of waste when producing tires. In the process of forming the tire itself, there is typically unused material (scrap) at the beginning and the end of the process. The inner lining of the tires is made with 2 different materials, textile or steel. Each of those fibers is wrapped with rubber and is then molded together and compressed to form a sheet and loaded onto carts. Upon completion of the process, there is a considerable amount of leftover material remaining on each cart. It is believed that if we can reutilize the material remaining on the carts that we will be able to affect a cost savings in the form of a reduction in scrap generation. The goal of this project is to find a solution that will reduce scrap by a target of 2%.

**1:20-1:35** Design of low wind speeds energy harvesters. **Jamshid E. Farzidayeri**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Wind power is a resource harvested to provide clean and renewable energy as a way to offset the use of fossil fuels. The process converts fluid flow across a turbine that traditionally moves a rotor within a stator to generate electricity. Although wind harvesting is typically relegated to large-scale production, significant research has gone into creating innovative small-scale designs. These systems incorporate a variety of conversion mechanisms including having a vibrating device strike a piezoelectric, using rotational motion to drive a rotor within a stator, and utilizing mechanisms that transform rotational motion to linear in combination with magnetic induction. The design considerations are to harvest maximum power with a limited footprint while operating below a moderate breeze. With the current state of small-scale harvesters generating up to 60 mW and some operating at 1.52 m/s wind speed, they offer a promising alternative method of powering small electronic devices.

**1:35-1:50** Molecular dynamic simulation of electroporation in chemo-treated cancer cells. **Khalid Tantawi** **Matthew Colson\***, *University of Tennessee at Chattanooga, Chattanooga, Tennessee*. In this work we use molecular dynamic simulation of a lipid bilayer membrane that is formed from phosphatidylserine phospholipids. The simulation was conducted using the CHARMM-GUI online platform, and simulations were run for an electric potential across the LBM from 10 mV to 1000 mV at different interval sizes for 100 picoseconds and 300 picoseconds. All the simulations for the electric potential returned intact lipid bilayers for the first 100 ps after an electric field was applied. The simulations for an electric potential of 900 mV and 1000 mV resulted in the formation of several temporary nanopores, and lipid bilayer disruption could be observed within 300 picoseconds of applying the electric field.

**1:50-2:05** Overview of design and development of energy harvesting devices and systems. **Vishwas Bedekar**, *Middle Tennessee State University*. The diminishing conventional energy sources based on fossil fuels have prompted research and advancement in renewable and non-conventional energy sources. Some of these energy sources that's abundantly available are mechanical vibrations, solar energy, wind and fluids. In this presentation, an overview of energy harvesting devices and systems using various mechanisms such as piezoelectric effect, magnetoelectric effect and dynamo effect will be investigated. Although the actual energy output is small from these energy harvesters, it provides a viable alternative to provide energy to on-board small scale electronic devices. The presentation will also highlight research on broadband energy harvesting systems and its applications. This research will provide the foundation to the research community to further investigate multimodal and multi-mechanism energy harvesting solutions.

**Geology & Geography**  
**Chair: Dr. Larry Knox**  
**1:00 pm – 2:50 pm**  
**Ferrell-Westbrook, rm 121C**

**1:00-1:05** Business Meeting

**1:05-1:20** Innovative summer camps to expose young girls to STEM career fields using the Coon Creek fossil deposit. **Natalie D. Hudson\***, **Michael A. Gibson**, **Emma C. Hughes\***, **Jack S. Garrett\***, and **Elizabeth C. Rhenberg**, *The University of Tennessee at Martin Coon Creek Science Center, Adamsville, Tennessee (NH, MG, EH, JG) and West Virginia Geological Survey (ER)*. The UT Martin Coon Creek Science Center partnered with the Museum of Science and History (MoSH) and Girls Inc. to run six one-week camps funded by the Alliance of Women Philanthropists for girls to introduce them to geology careers. Each week-long camp consisted of up to 20 girls from 8 to 16 years old. Girls Inc. staff provided programming to bolster the girl's confidence and perceptions of themselves, and self-discipline; UTM promoted the scientific method, geological principles and processes, and STEM career paths. Each camp included an interview of a female paleontologist as a role model. The girls collected Cretaceous sediment and fossils to research (identification, taxonomy, paleoecologic and paleoenvironmental reconstruction, and evolutionary history). Open-ended guided-inquiry pedagogies were employed to allow the girls to experience all phases of scientific inquiry. Group posters based upon their research were presented to a younger Girls Inc. cadre as a capstone experience.

**1:20-1:35** Anthropogenic influences on the fate of sediment in Big East Fork, Tennessee. **Brandt Tate\***, **Steven Goodbred**, and **Thomas Byl**, *Vanderbilt University, Nashville, Tennessee, and Tennessee State University (BT, SG), Nashville, Tennessee (TB)*. Located in Williamson County, Tennessee, Big East Fork (BEF) is comprised of numerous hillslope/valley systems, or subcatchments, that interact to supply sediment to the main valley of BEF. Logging events taking place in the late 19th century and early 20th century may have dramatically altered the storage and transport of sediment throughout BEF, causing an influx of mass to enter the BEF main valley. Collecting point data (depth to bedrock, channel width, ratio of mud/gravel, number of floodplains, length of floodplains, valley width [toe to toe], channel width, and the total stream volume) every 50 meters from the mouth to the headwaters of the channel in each subcatchment will provide the needed results to describe the mass transport within each subcatchment, ultimately describing the entirety of the BEF hillslope/valley system. A non-steady state system is expected due to the variance in bedrock type, elevation, and landscape geomorphology of each subcatchment comprising BEF.

**1:35-1:50** Geochemistry of the Copper Ridge Dolomite in the western Highland Rim, Tennessee. **Michael Bradley**, *Bradley Environmental*. Groundwater quality data available from the Copper Ridge Dolomite Rim indicate a distinct difference in the groundwater characteristics and geochemistry of the Copper Ridge Dolomite between two areas of the western Highland Rim. The Copper Ridge Dolomite occurs at about 3,000 to 4,000 feet below land surface with data available from a limited number of sites. The geochemistry for the Copper Ridge Dolomite in Perry County is unique and distinctly different from conditions observed at other sites. Water-quality analysis for Perry County indicates groundwater with relatively low dissolved solids and a mixed calcium-sodium-bicarbonate water type. Data from multiple wells in Humphreys County show groundwater with higher dissolved-solids, higher dissolved fluoride, and distinctly different sodium-chloride water-type. The differences in the water-quality and geochemistry in the Copper Ridge Dolomite between Perry County and Humphreys County are controlled by differences in the geologic structure, groundwater hydrology, and recharge to the deeper aquifers.

**1:50-2:05** Enigmatic calamite-like organic fossil from the Lower Devonian Rockhouse Limestone Member of the Ross Formation, West Tennessee. **Michael A. Gibson**, *The University of Tennessee at Martin, Martin, Tennessee*. A single occurrence of a calamite-like organic fossil is preserved as a black organic sheath within a brachiopod, trilobite, pelmatozoan calcareous shale within the Rockhouse Limestone Member of the Lower Devonian Ross Formation exposed in the Vulcan Materials Quarry near Parsons,

Tennessee. The specimen is concave into the shale, straight-sided, 8 cm long by 3 cm wide and has regularly spaced “annulations” or “nodes” averaging 8 mm apart. The surface is ornamented with straight parallel “ribs” 1-2 mm wide composed of regularly spaced, fine, thread-like lines (annulations?) oriented perpendicular to each of the “ribs”. The specimen resembles the sphenophyte *Calamites*, which is common in the Late Paleozoic. Its occurrence within a wholly marine calcareous shale is enigmatic but may indicate a wetland forest somewhere nearby enough to provide a floated specimen as well as occurring too early for this genus.

**2:05-2:20** Problematic body fossils from the Fort Payne Formation (Mississippian, Osagean) of Tennessee. **Larry W. Knox**, *Tennessee Technological University, Cookeville, Tennessee*. In the Fort Payne Formation enigmatic body fossils occur in association with siliciclastic mudmounds. The first problematic fossil is represented by a single calcareous specimen about 4 mm in diameter. It consists of eight S-shaped filaments that radiate from a central axis. Some elements bifurcate from an axial filament; others join the axis directly. Filaments increase in diameter for half their length and thereafter maintain the same diameter. The second consists of numerous tubular fossils that are circular in diameter (0.5 mm) and some 20 mm in length. The tubes bear transverse annular ridges distributed at approximately regular intervals. Some tubes are single; others occur in clusters of three or four individuals. The tubes are parallel-sided and do not divide. They resemble crinoid columnals, but lack the radial, interlocking grooves and ridges (crenellae and culmina) typical of most cylindrical crinoid stem segments. Additionally, crinoid stems generally do not occur in clusters.

**2:20-2:35** Possible contribution of harmful algal blooms to mussel die-offs in the Clinch River, Tennessee and Virginia. **Kristi Hill\***, **Jeronimo Da Silva Neto**, **Rose Agbalog**, **Champagne Cunningham**, and **Thomas Byl**, *Tennessee State University, Nashville, Tennessee (KH, CC, TB)*, *University of Tennessee, Knoxville, Tennessee (JDS)*, *US Fish and Wildlife, Virginia (RA)*, *U.S. Geological Survey, Nashville, Tennessee (KH, CC, TB)*. Pheasant shell mussel population declines in the Clinch River are an ongoing concern. Numerous hypotheses have been explored but a single driver of the die-offs has yet to be determined. Researchers are considering that a combination of factors play a role in the mussel die-off. Microcystin (MC) has recently become a more explored cause of other aquatic biological deaths. The current study explores correlations between mussel decline and MC. Passive samplers deployed at 4 mussel shoals, along with mussels and water were analyzed for toxins. Two sample sites were identified as priority die-off zones and showed moderate to high MC levels in November 2021 following a fall mussel die-off. The correlation between higher MC toxin and mussel deaths supports the hypothesis that cyanotoxins may contribute to mussel deaths in the Clinch, but further research is needed to fully understand the cause.

**2:35-2:50** Three algal toxins identified in late Cretaceous mollusk shells. **Champagne Cunningham\***, **Tom Byl**, **Michael Gibson**, **Michael Bradley**, **Jean Self-Trail**, **Steve Geiger**, **Jessica Oster**, and **Neil Kelley**, *U.S. Geological Survey, Nashville, Tennessee, (CC, TB, MB, JST)*, *University of Tennessee, Martin, Tennessee (MG)*, *Tennessee State University, Nashville, Tennessee (CC, TB)*, *Florida Fish and Wildlife Commission, Florida (SG)*, *Vanderbilt University, Nashville*. The Coon Creek fossil site in Adamsville, TN is a Cretaceous shallow marine deposit with over 400 species of preserved fossil clams, oysters, snails, crabs, lobsters, swimming reptiles such as mosasaurs, turtles, plesiosaurs, and fish. Dinoflagellates and cyanobacteria capable of causing red tides and harmful algal blooms were identified amongst the microfossils at this site. The objective of this project was to determine if algal toxins were present in Coon Creek fossil mollusk shells and sediments, possibly due to a red tide event contributing to the demise of air-breathing reptiles found near each other at the site. Shell extracts were analyzed using ELISA techniques. Trace amounts of 3 algal toxins, microcystin, saxitoxin and brevetoxin, were identified in Coon Creek oyster and clam shells. Modern-day oyster and clam shells collected from sites with known algal toxins had similar results.

**Health & Medical Sciences**  
**Chair: Dr. Aliyar Fouladkhah**  
**1:00 pm – 1:50 pm**  
**Humphries, rm 103**

**1:00-1:05** Business Meeting

**1:05-1:20** Rapid detection of pathogenic E. coli based on CRISPR technology. **Pallavi Rathore, Agnes Kilonzo-Nthenge, Korsi Dumenyo, Zeinab Yadegari and Ali Taheri**, *Tennessee State University, Nashville, Tennessee ( PR, AN, KD, AT), Fisk University, Nashville, Tennessee (ZY)*. Detection of foodborne pathogens such as pathogenic Escherichia coli, is essential for public safety. Conventional methods for detecting these bacteria are based on culturing on selective media and following standard biochemical identification. Despite their accuracy, these methods are time consuming. PCR-based detection of pathogens rely on sophisticated and time-consuming protocols and specialized technicians which are difficult to find in areas with limited resources. In this project, we are developing a robust detection method based on CRISPR-Cas12a sensing which is rapid, highly sensitive and specific for detection of pathogenic E. coli. Detection reaction contained amplified PCR products for the pathogenic regions, reporter probe, Cas12a enzyme, and crRNA that is specific to the pathogenic gene. This project can result in a versatile detection method that is easily adaptable for Rapid Response in the detection and surveillance of diseases that pose large-scale biosecurity threats to human health, and plant and animal production.

**1:20-1:35** The tale of the tail: Understanding the role of the C-Terminal domain of Topoisomerase II. **Lauren A. Fielding\*, Emma Baxter\*, Clay Durham\*, Daniel England\*, Jessica Musselman\*, and Joseph E. Deweese**, *Freed-Hardeman University, Henderson, TN (LF, EB, CD, DE, JM, JD) and Vanderbilt University, Nashville, TN (JD)*. Human topoisomerase II $\alpha$  (TOP2A) is a nuclear enzyme that alters DNA topology during cellular transcription and replication. TOP2A has an intrinsically disordered C-terminal domain (CTD). We have designed and characterized multiple CTD mutants (with one to seven amino acids mutated per mutant) of TOP2A to explore the impact on catalytic activity. The current studies focus on a group of mutants that show the largest effects on catalytic activity. Using a thiosemicarbazone TOP2 inhibitor, Cu(APY-ETSC)Cl (CuAPY), results indicate that these mutants are all still inhibited by CuAPY. Interestingly, CuAPY increased the proportion of double stranded breaks to single stranded breaks with mutant 4. In other experiments, we measured the stability of DNA binding to the enzyme in the presence of ATP, AMP-PNP, and CuAPY and found variable responses depending on the mutant. Taken together, the results indicate that mutations in the CTD do impact the catalytic activity of TOP2A.

**1:35-1:50** Using math to study proteins: Application of PSICalc to Topoisomerase II. **Clark Endsley\*, Kori Moore\*, and Joseph E. Deweese**, *Freed-Hardeman University, Henderson, TN (CE, KM, JD), and Vanderbilt University, Nashville, TN (JD)*. The PSICalc software tool identifies protein sequence interdependencies including amino acid positions that either interact in the protein or are mutually dependent. We applied PSICalc to topoisomerase II $\alpha$  (TOP2A) to identify interdependencies between the C-terminal domain (CTD) and the rest of the protein. There is evidence that the CTD regulates activity of the protein. PSICalc analysis of TOP2A sequences identified amino acid clusters between different domains including the intrinsically disordered CTD and the ATPase domain. These clusters included amino acid positions that were previously mutated by our research group. For example, a mutation was made at residue 1430 and there were interdependencies found among position 1430 and residues 119, 120, and 126, which is consistent with biochemical data. PSICalc results are being used to design TOP2A mutants in order to explore these interdependencies. In conclusion, PSICalc explores protein structure and function through identifying interdependencies in the protein sequence.



**History of Science  
Physics & Astronomy  
Science & Math Teaching**

**Chairs: Dr. Soma Banerjee, Dr. Robert Pattie, Dr. Philip Short**

**1:00 pm – 2:35 pm**

**Humphries, rm 221**

**1:00-1:05** Business Meeting – there will three separate business meetings held.

**1:05-1:20** Exposing students to diversity using science history. **Braden W. Huff\*** and **Sarah S. Pierce**, *Cumberland University, Lebanon, Tennessee*. Studies have shown that students with marginalized identities are less likely to graduate with STEM majors. Diversity is an important aspect of science because it can help motivate students with marginalized identities to pursue STEM majors. The goal of this research was to find recent scientific historical figures that represent diversity within the sciences. Diversity can refer to multiple ways students identify themselves including gender, race/ethnicity, nationality, disability status, and sexual orientation. We have researched eleven recent historical figures that exhibit diversity within the science community. These individuals are Alma Hayden, Apoorva Mandavilli, Ahmed Zewail, Benjamin List, Bettye Greene, Ben Barres, Barbara McClintock, Martha Chase, Katherine Johnson, Stephen Hawking, Reiji Okazaki, and Tsuneko Okazaki. Through the use of these individuals, we can better represent all communities, ethnicities, and minorities within the science and STEM fields.

**1:20-1:35** Hypatia of Alexandria. **John J. Schommer**, *University of Tennessee at Martin, Martin, Tennessee*. Hypatia of Alexandria was a female mathematician born in the fourth century of the common era. With relatively few ancient sources that tell of her life (some of which are contradictory), an objective historian is presented with many difficulties. Speculation is unavoidable. One of the few things we do know is that she died a horrific death in 415 C.E. after establishing herself as a well-known Neoplatonist philosopher, mathematician, and astronomer. It is precisely the spectacular nature of her death which drives some of the speculation about her life into, perhaps, unwarranted territory. In this talk we will discuss what is known with some certainty about Hypatia and the general difficulty of speculating responsibly about her life.

**1:35-1:50** Observing and Simulating Magnetic Microparticle Hopping on Permalloy Disks. **Gregory Vieira, Chris Hoang, Ryan Simms, and Eliza Howard**, *Rhodes College, Memphis, Tennessee*. Magnetic microspheres are commercially-available, fluid-borne particles made of iron oxide encapsulated in polystyrene. These microspheres are designed for bioseparation of cells, proteins, DNA, and RNA, whereas they can be specifically bound to these targets allowing for field gradients to separate the particles from a mixture. We study the transport of these particles about grids of permalloy disks, driven by varying, weak ( $<100$  Oe) magnetic fields. Recent work has been done in the development of surface-based transport schemes and methods of applying tunable magnetic forces, showing promise for use in on-chip devices. I will discuss some of the applications of this chip-based technique as well as phenomena that arise during transport, for example variation in particle speed with external fields and transition from ordered to disordered transport. We use results from these experiments to develop competing computer models for the purpose of understanding magnetic characteristics of both the microparticles (i.e. susceptibility) as well as the permalloy disks (i.e. magnetization landscapes).

**1:50-2:05** The Stellar Component of the NGC-6253 Field. **J. Allyn Smith, April M. Torres\***, *Austin Peay State University, Clarksville, Tennessee*. The old, open cluster NGC-6253 was observed in September 2018 using the CTIO-0.9m+CFCCD. We present highlights of the results of this study, including the bright stellar component of the field and the selection of cluster members. We integrate our results for the cluster members with GAIA-DR3 and 2MASS data, present results for the field stars in the cluster area, and discuss recovery of known variable stars using our limited data sets. We discuss ongoing use of these data as part of a Gemini program studying this cluster.

**2:05-2:20** Chemistry of cochineal dye used for dyeing. **Claire Authement and Anuradha Pathirana**, *Austin Peay State University, Clarksville, Tennessee*. Context-based learning has become a popular topic of interest to many programs across the United States, especially for STEM programs. Because of how diverse these classes can become semester by semester it is often hard for educators to engage students who do not major in a STEM program. Retention of students from both scientific and nonscientific backgrounds necessitates an understanding based on everyday application. The overall goal of our project is to familiarize students with the dyeing process using natural dyes from easy-to-access resources. Using a comparison of synthetic dyes, and various mordants including alum, copper, zinc chloride, and lead sulfate, a range of fabrics were dyed with carminic acid derived from a scaled insect, cochineal, at different temperatures and pH. This illuminates awareness of sustainable and environmental chemistry, the differences between various compounds, and a focus on the chemistry of the dyeing process.

**2:20-2:35** Teaching intermolecular forces using watercolor paintings. **Kathleen Oliver\*, Julie Baker Phillips, Vichuda Hunter, and Sarah S. Pierce**, *Cumberland University, Lebanon, Tennessee*. Intermolecular forces are one of the important foundational concepts in chemistry, and students apply this concept throughout different chemistry courses in the curriculum. Previous studies have shown the importance of student understanding of this concept, how well students apply this knowledge, and how students retain the information. This study investigates how an authentic learning experience impacts student understanding of intermolecular forces. The goal of this study was to investigate the effectiveness of an authentic learning experience by examining students' improvement between pretests and posttests. To investigate this, students in different chemistry courses were given a lecture on intermolecular forces and participated in a lab activity on the concept. Results show that the scores of Fundamentals of Chemistry, General Chemistry, and Organic Chemistry students significantly improved between the pretest and posttest. This suggests that this activity is beneficial for students enrolled in various leveled chemistry courses.

### **Math and Computer Science**

**Chair: Dr. Ramanjit K. Sahi**

**1:00 pm – 2:50 pm**

**Humphries, rm 327**

**1:00-1:05** Business Meeting

**1:05-1:20** Performance measure for real estate mutual funds. **Amber King\*, Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. For an investor, risk and return are very important tools for portfolio analysis. In this project, we will look at the real estate mutual funds through the lens of risk and return. Specifically, we will be looking at the Sharpe ratio to measure the performance of real estate mutual funds. Data sets from the Morning Star mutual fund database will be used. Using risk related characteristics, the Sharpe ratio will be used to analyze the performance of each mutual fund.

**1:20-1:35** Preliminary study of budget allocation in a non-profit grant-funded organization. **Anthony Thai\*, Dyana Taylor, Mike Wilson and Ramanjit Sahi**, *Austin Peay State University, Clarksville, Tennessee*. The most critical factor in the productivity of any non-profit organization is the management of its funding. In this project, we will be studying the budget allocation of the Geographic Information Systems (GIS) center at Austin Peay State University (APSU). The APSU GIS center is a unique case as an organization that is funded entirely by grants from external sources, each with its own terms and conditions on use. Because of the nature of its funding, the APSU GIS center faces several financial challenges in budget allocation and in reconciliation with numerous external entities. To meet these challenges, we will investigate the finances of the APSU GIS center to devise an organizational structure that optimizes budget allocation while maintaining accurate accounting that is easily reconcilable with multiple external entities.

**1:35-1:50** Descriptive analysis of Puerto Rico excess mortality after Hurricane Maria. **April Torres\***, **Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. A category 4, Hurricane Maria devastated the infrastructure and disrupted the organizations of Puerto Rico on September 20, 2017. Estimates of excess mortality from academics and investigative journalists created a controversy over the official death as given by the Puerto Rico government. One of the ways to estimate excess mortality from natural disasters is by establishing a counterfactual estimate of mortality had the disaster not occurred. For a counterfactual estimate, it is essential to investigate the size and changes to at-risk population distribution. In our research, we will do a descriptive analysis of Puerto Rico's mortality by age and sex before and after the hurricane.

**1:50-2:05** Understanding forensics through statistics lens. **Chloe Hemmelgarn\***, **Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Forensic Science is a multifaceted degree of study that envelops several different types of crime scene. The crime scene evidence requires statistical analysis to be completed to formulate a credible case to be presented in court. In this project, we studied a court case where blood was found at the crime scene. For this case, statistical analysis is applied on the data collected to be used for evidence in the court in the defense or prosecution of the suspect. Our statistical results provided a weak support for the case itself.

**2:05-2:20** Statistical analysis of dengue fever in the Philippines. **Christine Grace A Bandol \***, **Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. The Philippines' geographical location and amount of annual rainfalls causes the proliferation of Dengue Fever, a mosquito-borne viral disease. Dengue Fever is endemic in the Philippines and is one of the leading causes of hospitalization and death every year. In this project, I will apply statistical analysis to study the dengue fever. This study will help in the research, management and prevention of this prevalent disease.

**2:20-2:35** Application of mathematics in civil engineering. **Roland Sevidzem Fani\***, **Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Civil engineering provides tools that are essential to modern life such as buildings (schools, hospitals, factories), highway systems, water treatment plants etc. A civil engineer deals with planning, designing, constructing, and operating the facilities that are needed for basic functioning of human activities. The goal of this study is to show how civil engineers apply mathematical equations via computer-based programs in the design and realization of projects efficiently. For instance, basic algebra is used in calculating the budget (cost) of the project, mathematical equations are applied in structural design, and calculus, statistics, and geometry are used for road design. Thus, we see how vital the applications of mathematics in civil engineering are.

**2:35-2:50** The efficacy of cost-saving travel policies. **Stephen J. Robinson**, *Belmont University, Nashville, Tennessee*. We analyze the average cost savings for a policy in which the shorter of two distances to a conference is always used to calculate mileage reimbursement. We calculate and simulate probabilities of flying and driving random distances (with and without regional bias) to determine expectation values of mileage and cost saved and whether such a policy works as intended.

**Microbiology**  
**Chair: Dr. Sergei Markov**  
**1:00 pm – 2:35 pm**  
**Ag Biotech, TR (1<sup>st</sup> floor)**

**1:00-1:05** Business Meeting

**1:05-1:20** Antibiotics use and antimicrobial resistance profiles in small-scale goat and sheep farms. **Tobenna Aniume\***, and **Agnes Kilonzo-Nthenge**, *Tennessee State University, Nashville, Tennessee*. Zoonotic transmission of antibiotic resistant bacteria is a major burden in public health. The aim of this study was to determine the use of antibiotics and antimicrobial resistant profiles in goat and sheep farms. Questionnaire data on antibiotic use was collected by Qualtrics survey from approximately 151 farmers across Tennessee and Georgia. Descriptive analysis of data was performed by using SPSS. Antibiotic sensitivity of bacteria was performed using Kirby-Bauer disk diffusion method. About 80% of farmers used antibiotics with Oxytetracycline (31.3%), Penicillin G, (25.8%) and Florfenicol (17.5%) being the most frequently used. About 73.5% of respondents consulted veterinarian on needs basis while 11.9% never consulted. *Escherichia coli*, *Shigella*, *Salmonella* and *Staphylococcus aureus* displayed resistance to ampicillin (28.5%, 0%, 37.8%, and 95%) and tetracycline (11.5%, 100%, 16% and 100%). This study shows that zoonotic antimicrobial resistant pathogens are linked to small ruminants; hence it remains imperative that antibiotics are used prudently.

**1:20-1:35** Commonalities of tRNA present in Cluster A mycobacteriophage genomes and their effects on *Mycobacterium tuberculosis* infection. **Miriam Galindo\*** and **Elvira Eivazova**. *Columbia State Community College, Columbia, Tennessee*. Bacteria resistant to multiple antibiotics are a serious worldwide problem. As a consequence, some types of infections are becoming increasingly difficult to treat with antibiotics. The use of bacteriophages, also called phages, brings many advantages as phages infect only bacteria and are harmless to people. The goal of our study was to characterize the Cluster A Mycobacteriophages that infect mycobacterial hosts, such as *Mycobacterium tuberculosis*. Cluster A, which contains mostly temperate viruses, is the largest cluster of phages published to the NCBI GeneBank. Sequenced genomes for 471 mycobacteriophages were comparatively analyzed according to their shared gene content and the occurrence of tRNA genes. We found that thirty-two tRNA genes coding for 4 amino acids were observed among cluster A phages. We conclude that there is a direct correlation between the presence of tRNA genes in mycobacteriophage genomes and their ability to effectively infect *M. tuberculosis*.

**1:35-1:50** Investigation of the prevalence of the Trichy protozoan parasite, *Trichomonas gallinae*, in hunter-harvested mourning doves (*Zenaid macroura*) from east Tennessee. **Morgan D. Simpson\*** and **Kathryn E. Purple**, *Lincoln Memorial University, Harrogate, Tennessee*. Mourning doves (*Zenaid macroura*), the most hunted game bird in North America, are negatively impacted by trichomonosis epizootics. *Trichomonas* spp. have been responsible for significant mortality throughout recorded history. Our aim is to determine the prevalence of *Trichomonas* spp. in hunter-killed mourning doves harvested from four seasons at the Forks of the River Wildlife Management Area in east Tennessee. The oral cavities of the doves were inspected for lesions and swabbed with cotton-tipped applicators. Swabs were introduced into Hollander Fluid media, incubated at 37°C, and read by light microscopy every other day for 5 days. The prevalence of *Trichomonas* by culture was 2.1% (4/189) in 2016, 0% (0/50) in 2017, 2% (1/50) in 2021, and 2.1% (1/48) 2022, which is similar to that in other healthy U.S. dove populations. Culture samples were frozen at -20°C for DNA extraction, PCR, and sequencing. These data will help guide harvesting and management strategies.

**1:50-2:05** Ultraviolet light emitting diode systems for surface decontamination of micro-organism on food contact surfaces. **Aakash Sharma\***, **Brahmaiah Pendyala**, **Housyn Mahmoud** and **Ankit Patras**, *Tennessee State University, Nashville, Tennessee*. Considerable evidence exists that environmental contamination with airborne microorganisms poses a risk for air and food contact surfaces through the transmission of these organisms. Air is an established microbial contaminant. Disinfection is more

effective using UV-C than traditional cleaning practices. We studied the inactivation of *Escherichia coli* ATCC-25922 on contact surfaces using UV-C LED (279 nm), with UV intensity characterization via optical fiber ( $\mu\text{W}/\text{cm}^2/\text{nm}$ ). 50 $\mu\text{L}$  of cell suspension was placed and spread uniformly over the 1" circular coupon, which was treated at UV-C doses 0, 4 & 8  $\text{mJ}\cdot\text{cm}^{-2}$ . 3 log inactivation was achieved at maximum dose of 8  $\text{mJ}\cdot\text{cm}^{-2}$  demonstrating a D10 value of  $2.71\pm 0.16$   $\text{mJ}/\text{cm}^2$ . This study showed the suitability of using novel UV-C LED systems to inactivate *Escherichia coli* on model food contact surfaces. Results from this study will help to calculate the UV-C doses for practical delivery for targeted *Escherichia coli* log reductions on contact surfaces.

**2:05-2:20** Use of electronic nose: A metabolomic approach to identify the unique volatile compounds produced during soft rot disease of carrot. **Harpreet Kaur\***, **Bimala Acharya\***, **Michael Addogoh**, **Ramasamy Ravi** and **C. Korsi Dumenyo**, *Tennessee State University, Nashville, Tennessee*. Soft rot disease is caused by bacteria *Pectobacterium* and *Dickeya* spp, which secrete an assortment of exoproteins including plant cell wall-degrading enzymes responsible for rotting and decay of host tissue during infection. This rotting disease produces characteristic smell, which could be diagnostic of the host-pathogen interaction. This study was conducted to determine the unique volatile compounds produced when *P. versatile* interacts with carrot roots disks during soft rot disease manifestation. Using e-nose sensory machine, we identified and quantified different volatile compounds that are present in the carrot extract, minimal medium supplemented by carrot extract (MM-CaE), culture of *P. versatile* in MM+CaE medium and carrot tissue macerated by *P. versatile*. Principal Component Analysis (PCA) indicate that same compounds are only present in culture and macerated tissue indicates products of host-pathogen interaction. The identified compounds are 2-Phenylethyl phenyl acetate, 4-Undecanolide, Anisyl alcohol, butane-2,3-dione, ethyl isobutyrate, Ethyl Octanoate, Ethyl propanoate, gamma-nonalactone.

**2:20-2:35** Zoospore productions and inactivation of plant pathogenic oomycetes using UV-C LED irradiation. **Bhawana Ghimire\***, **Brahmaiah Pendyala**, **Ankit Patras**, and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville Tennessee (BG, FBG), and Tennessee State University, Nashville, Tennessee (BP, AP)*. *Phytophthora cinnamomi*, *Phytophthora nicotianae*, and *Phytophthora helicoides* are devastating plant pathogens circulating in irrigation water. Use of germicidal UV-C light (240-290 nm) to treat water could be a novel alternative to chemicals. Volumetric fluence rate based on the optical properties of the pathogen zoospore suspension was quantified and UV-C dose was calculated as a product of average fluence ( $\text{mW}\cdot\text{cm}^{-2}$ ) x exposure time (secs). Suspensions were exposed to quantifiable UV-C doses of 2, 4, 6, 8, 10, 12 and 15  $\text{mJ}\cdot\text{cm}^2$  under stirred conditions and surviving populations were counted. A log-linear model was fitted to the experimental data ( $R^2 = 0.97, 0.96, \text{ and } 0.97$  RMSE = 0.13, 0.11, and 0.065  $K_{\text{max}} = 0.43, 0.52, \text{ and } 0.16$ ) and D10 values (5.56, 5.14 and 14.70  $\text{mJ}\cdot\text{cm}^2$ ) were calculated for *P. cinnamomi*, *P. nicotianae*, and *Pp. helicoides*, respectively. This study clearly demonstrated the efficacy of UV-C LED system in activating plant pathogenic oomycetes.

**Physics & Astronomy**  
**Chair: Dr. Robert Pattie**  
**Ferrell-Westbrook, rm 117-119**

**Meets with History of Science & Math and Science Teaching**

**Science and Math Teaching**  
**Chair: Dr. Philip Short**  
**Ferrell-Westbrook, rm 117-119**

**Meets with History of Science & Math and Science Teaching**

**Zoology**  
**Chair: Dr. Julie Baker Phillips**  
**1:00 pm – 2:35pm**  
**Humphries, rm 320**

**1:00-1:05** Business Meeting

**1:05-1:20** Diversity and prevalence of *Ehrlichia* spp. detected in Ixodid ticks from the Cumberland Gap region of Tennessee, Virginia, and Kentucky. **Hannah F. Blevins\***, and **Barbara C. Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. *Ehrlichia* spp. are transmitted to animals and humans through the bite of an infected Ixodid tick, particularly bites from *Amblyomma americanum* and *Ixodes scapularis*. The main three species of *Ehrlichia* that affect humans in the United States are *E. ewingii*, *E. chaffeensis* and *E. muris eauclairensis*; however, novel species continue to be discovered. Ehrlichiosis can result in fever, aches, nausea, as well as mortality. Humans, domestic animals, and wildlife are vulnerable to infection. In this study, we screened tick DNA samples from the Cumberland Gap Area of Tennessee, Virginia, and Kentucky via polymerase chain reaction. These tick samples were collected from 2016-2020 and contain the genera *Ixodes*, *Amblyomma*, *Dermacentor*, and *Rhipicephalus*. Positive amplicons were then sequenced to determine the species of *Ehrlichia*. These data will contribute to our growing knowledge of tick-transmitted diseases in Appalachia as well as the diversity of *Ehrlichia* spp. in the United States.

**1:20-1:35** Activity of ticks from various habitats and times of day, and corresponding infection status with *Borrelia* spp. and *Babesia* spp. **Emily S. Roark\***, and **Barbara C. Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. Understanding tick phenology can help to prevent human infection, especially important as tick-transmitted diseases are on the rise in North America. This study examines the activity of ticks in Knox County, Tennessee from different times of day and habitat types as well as infection prevalence of *Borrelia* spp. and *Babesia* spp. Ticks were collected over a four-month period in three different habitats (short grass, tall grass, and wooded areas) at three times of day (morning, afternoon, and evening). Ticks were identified to species prior to DNA extraction: *Ixodes* spp. (n=2), *Dermacentor variabilis* (n=17), *Amblyomma americanum* (n=12). PCR is underway to screen ticks for *Borrelia* spp. and *Babesia* spp. Currently four (n=11, 36%) amplified *Babesia* spp. DNA. Statistics and positive amplicon sequencing are pending. These data contribute to our growing knowledge of tick natural history in Appalachia.

**1:35-1:50** Infectious Diseases of Domestic Cats (*Felis catus*) in Kentucky, Virginia, and Tennessee. **Madison Criswell\***, **Katherine Kirkendall\***, **Vina Faulkner**, **Matthew Marcum**, **Barbara C. Shock**, and **Karen Gruszynski**, *Lincoln Memorial University, Harrogate, Tennessee*. The objective of this study was to determine the prevalence of infectious diseases among cats from neighboring portions of Virginia, Tennessee, and Kentucky. Blood and fecal samples from both groups were tested using IDEXX real-time PCR assay anemia panel and centrifugal flotation, respectively. FIV (1/62, 1.6%), FeLV (1/62, 1.6%), and *Bartonella* spp. (2/62, 3.2%) were identified only in community cats. Mycoplasmas were detected in both shelter and community cats (11/62, 17.7%). *Toxocara cati* (14/75, 18.7%) and *Ancylostoma tubaeforme* (4/75, 5.3%) were only identified in community cats. More shelter cat fecal samples were positive for *Cystoisospora* spp. (4/25, 16%) compared to community cats (2/50, 4%), while *Dipylidium caninum* was more prevalent in shelter cats (2/25, 8%) compared to community cats (3/51, 5.9%). Community cats harbored a wider variety of pathogens, and due to roaming behaviors may be more likely to pose a potential health risk to both cats and humans.

**1:50-2:05** Rate of dispersion associated with precipitation level and sex in raccoons in southwestern Tennessee. **Liam D. Catron\***, **John R. Hisey**, **Evelyn Chukwurah**, and **Michael L. Kennedy**, *Lee University, Cleveland, Tennessee (LDC, JRH)*, *University of South Carolina, Columbia, South Carolina (EC)*, and *The University of Memphis, Memphis, Tennessee (MLK)*. Raccoons are prominent pests and carriers of diseases that may transmit to other species, including humans. Although poorly understood, rates of dispersion related to sex and the dry and wet periods prevalent in the southern US are critical for

effective raccoon control. We investigated these factors through microsatellite genetic analysis of 440 raccoons live-trapped over 11 years in southwestern Tennessee. We observed dispersion between individuals in first-order-relative pairs (IFRP) in 22 and 70 cases, during a dry and wet period respectively. Mean dispersion rate was more than four times higher in the former and was also nearly four times higher for males than for females. Maximum female IFRP dispersion rate was 388.07904.3 m/year. In 8/92 IFRP observations, separation was >68,000m at a maximum and mean rate of 31,904.2 and 16,227.2m/year. Dispersion rate, which was sometimes rapid and long-range and differed by sex and precipitation levels may be informative for control strategies.

**2:05-2:20** Frequency and identification of nematodes in the intestinal tract of Northern Bobwhites *Colinus virginianus*. **Juan Torres\***, **Iga Stasiak**, **John Morgan**, **Cody M. Rhoden**, **Christen Casey**, and **Whitney Kistler**, *Lincoln Memorial University, Harrogate, Tennessee*. The Northern bobwhite *Colinus virginianus* has seen a population decline, starting from the 1960's to now. While habitat changes and urban expansion may have an effect on the decline, one factor that remains understudied is the effect of parasitic nematodes on the Northern bobwhite population in the United States. For this study, we analyzed nematodes extracted from the intestinal tract of Northern bobwhites collected from 2016 to 2018. Polymerase chain reaction (PCR) was performed on 29 tubes containing nematodes in order to identify which species are found in the intestinal tract of Northern bobwhites. This study will improve the understanding of which species of nematodes infect Northern bobwhites, which can be used by researchers and wildlife managers to better understand population decline factors.

**2:20-2:35** Use of Cable Restraints as a Tool to Safely Capture Coyotes Alive. **Edward L. Warr\***, **Roger D. Applegate**, **Steve W. Stephenson**, and **Michael L. Kennedy**, Department of Biological Sciences, The University of Memphis, Memphis, TN 38152 (ELW, MLK), Tennessee Wildlife Resources Agency, Wildlife Division, Nashville, TN 37204 (RDA), Department of the Army, Milan Army Ammunition Plant, Milan, TN 38358 (SWS), Present address: 168 Gilman Road, Bangor, ME 04401 (RDA) Using cable restraints were evaluated for effectiveness of live capture of coyotes and nontarget species. Coyotes were collected during the winters of 1985-86, 1989, and 1990 at Milan Army Ammunition Plant in Gibson and Carroll counties, Tennessee. Thirty-nine coyotes were captured in cable restraints in 1985-1986 with no mortalities. Of 53 captured in 1989, five were found dead in the restraint. In 1990, 52 coyotes were captured with only one cable-restraint mortality. Of the total coyote cable-restraint mortalities, five were in culvert sets (83%) and one was in a fence set (17%). There was no mortality recorded for 20 domestic dogs (*Canis familiaris*) captured in cable-restraints during the period of the study. Low mortality also was seen for eight additional nontarget species captured in the cable-restraints. Cable restraints are an effective method for live-capture of coyotes with minimal mortality of nontarget species.

## Poster Presentations

Ag Posters, Humphries Main Hallway; All other posters Westbrook-Ferrell hallways, 1<sup>st</sup> and 2<sup>nd</sup> floor.

### Agriculture Posters

**1-01** Genome-Wide Association study for root system architecture traits in field Soybean [*Glycine max* (L.) Merr.]. **Pallavi Rathore, Korsi Dumenyo, and Ali Taheri**, *Tennessee State University, Nashville, Tennessee*. Roots are the “hidden half” of the plants that play an important role in plant development by drawing water and nutrients from the soil and by providing anchorage to the plants. Climate change has caused an increase in global temperature that leads to higher stress on plants in water and nutrient uptakes. Hence there is a need to develop resilient crops with better Root System Architecture (RSA) that are able to survive and produce under these conditions. Unlike aerial crop traits, RSA traits are not easy to measure, and there are not enough studies on RSA traits. Here, we are studying 20 RSA traits in 500 soybean accessions on blue germination paper and performing Genome-wide Association Studies (GWAS) to identify genomic loci associated with the RSA traits. The candidate genes that are identified through this study can be further used in crop improvement and breeding projects to produce improved soybean cultivars.

**1-02** Agricultural water, soil and seed quality in the production of ready-to-eat leafy vegetables: prospective challenges and potential solutions. **Doofan Eke\*, Ukti Sheth\*, Samuel Haruna, Ying Gao, Tony V. Johnston, and Seockmo Ku**, *Middle Tennessee State University, Murfreesboro, Tennessee*. The phrase, "Health is wealth" has gained popularity and become evident in consumer selection of foods. Raw and partially cooked vegetables, especially leafy greens, have become very popular, making the safety of these foods a crucial issue from farm production through harvesting and processing. Contamination by a pathogenic organism (e.g., *E. coli*, *Salmonella* and *Listeria* spp.) can occur at any point in the process. This research sought to analyze likely entry points of pathogens into these foods during production and processing and provide solutions for controlling microbial contamination. Complete eradication of microbial contamination in leafy greens is impossible but the safety of their consumption can be increased by evaluating and controlling the quality of the soil and water used in their production on the farm. Seed treatment prior to planting is also a means of minimizing contamination of plant-based foods.

**1-03** Analysis of benefits and costs for a sustainable backyard plant nursery with conservation practices. **Sunil Gurung\*, Prabodh Illukpitiya, and Dharma Pitchay**, *Tennessee State University, Nashville, Tennessee*. Most of the ornamental, fruit and landscape tree nurseries fall under large-scale operations. There are opportunities to start this type of small nursery in one's backyard with lower capital costs. The objective of the research is to explore and design a model backyard plant nursery incorporating Best Management Practices (BMPs) of conservation. We used a 140-ft x 315-ft site as a model backyard nursery with several fruit and ornamental species. The start-up costs were segregated into various categories. Labor costs were based on actual labor days allocated for specific operations and current wage rate of skilled labor. Other input costs were based on market prices of inputs. Establishment costs were based on the market price of seedlings. Gross revenue was estimated based on anticipated market price of marketable plants. The analysis shows that growers could generate profit by investing in a backyard plant nursery with conservation practices.

**1-04** Anaplasmosis prevalence among herds in Weakley County, Tennessee. **Grant Funderburk\* and Amber Moore**, *University of Tennessee at Martin, Martin, Tennessee*. *Anaplasma marginale* is a rickettsial disease that infects the red blood cells of ruminant animals. It is transmitted most commonly by tick, blood contaminated equipment and biting flies. Clinical signs associated with *A. marginale* infections in naive adult cattle include severe anemia, jaundice, disorientation, and death. In our study, samples were collected from 162 cattle over 18 months of age from four herds in Weakley County, TN from April to September of 2022. Serum was sent to Kord Diagnostic Laboratory in Nashville and tested via cELISA. Out of these samples, 132 samples tested positive with 30 negative results. Herd prevalence ranged from



72.4 percent to 90.3 percent positives with an average prevalence of 81.5 percent. This information will be used to help inform producers in the area how best to minimize losses, better select for replacement animals, and manage the risk this disease imposes in local herds.

**1-05** Application of Koji for the hydrolysis of alternative sake grains. **Autumn Farrell, Seockmo Ku, and Tony V. Johnston**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Sake is a traditional Japanese alcoholic beverage made from rice, water, koji (mainly *Aspergillus* spp.), and yeast. Koji molds are known to produce 50 bioactive hydrolytic enzymes, including  $\alpha$ -,  $\beta$ - and  $\gamma$ -amylases. Their use in fermentation differs from traditional Western methods of malting and mashing, which relies on  $\alpha$ - and  $\beta$ -amylases to convert grain starch chains into fermentable sugars. In addition, malting and mashing requires heat while koji mold use does not. Koji-based parallel fermentation reduces energy consumption and allows saccharification and fermentation to occur simultaneously. This project sought to determine whether (i) Koji could be used as the enzyme source for the production of grain-based alcohol products through parallel fermentation, and (ii) the flavor of the finished products would differ from those produced by malting and mashing.

**1-06** Application of perennial sorghum into far east Asian alcoholic beverage production. **Anna Arnold\*, Shayla Sullivan\*, Colby Mearns\*, Weston Williams\*, Summer Miller\*, Sydney Lively\*, Christopher Utt-Grubb\*, Doofan Eke\*, Samuel Haruna, Pheonah Nabukalu, Song Cui, Tony V. Johnston, and Seockmo Ku**, *Middle Tennessee State University, Murfreesboro, Tennessee (AA, SS, CM, WW, SM, SL, CU, DE, SH, SC, TVG, SK), and The Land Institute, Salina, Kansas (PN)*. A new breed of perennial germplasm has been propagated in the United States. Due to this sorghum's subterranean rhizomes that stay in the ground all year long, there is potential to prevent soil degradation in the world's grain-growing regions and support sustainable agriculture practices. To encourage farmers to begin growing this perennial sorghum, our goal in this study is to create a new product cycle that includes it as the main ingredient. To our knowledge, sorghum has been used in the production of various Chinese spirits, but rarely in alcoholic beverages in other East Asian countries. In this work, we were able to produce two kinds of alcoholic beverages (cheongju and makgeolli) with complex fruit and floral flavors, and we were able to stimulate *Aspergillus oryzae* growth on the sorghum to produce makgeolli starter (koji). These products promise a potential outlook for future experimentation and expansion into further products.

**1-07** Application volume and adjuvant comparison for simulated pesticide drenches in nursery containers. **Caitlyn Benton\*, Anthony Witcher, and Karla Adesso**, *Middle Tennessee State University, Murfreesboro, Tennessee (CB), and Tennessee State University, McMinnville, Tennessee (AW, KA)*. Insecticide drenches are required to control certain regulatory insect pests prior to shipping container-grown nursery crops. Reduced insecticide drench volumes may mitigate excess leaching of insecticides. The objective was to evaluate the effects of reduced drench volumes and adjuvants on container substrate saturation and leaching. Signal Green dye was mixed with water and two adjuvants (Grounded and UpTake Pro) then applied in three volumes (1/5, 1/10, and 1/20 the container volume) to 3 gal nursery containers. Percent leaching increased with drench volume for all adjuvants and ranged 54 to 87% across all drench volumes. Grounded resulted in the greatest leaching overall and the lowest substrate water content. Leachate dye concentration was lowest for UpTake Pro, but substrate dye concentration was not affected by adjuvant. Overall, adjuvants did not improve substrate dye concentration compared to water alone. Further research will evaluate insecticide efficacy at reduced drench volumes.

**1-08** Assessing the costs involved with dogwood disease management in Tennessee nurseries. **Kumuditha Hikkaduwa Epa Liyanage, Anthony Witcher, Aditya Khanal, and Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Early and accurate detection of diseases and implementation of efficient management practices are crucial to reducing the economic impact associated with plant disease outbreaks. Currently available disease management techniques are labor-intensive and costly; hence growers are searching for least-cost disease management alternatives. The objective of this study is to determine the magnitude of disease management problems related to dogwood production in Tennessee. Pre-approved questionnaires were sent to 60 dogwood growers via email. According to the preliminary results, most of the container growers scout for diseases daily and field growers weekly involving 2 workers spending 2 hours also following pesticide spray schedules. The

average cost for foliar disease scouting is \$1,000 and the average cost for foliar disease spraying is more than \$2,000 per year. This cost-benefit analysis will be useful in identifying these labor-intensive disease management methods to be substituted with an automated system.

**1-09** Bovine Leukosis Virus in cattle herds across Weakley County, Tennessee. **Mackenzie Moody\* and Amber Moore**, *University of Tennessee at Martin, Martin, Tennessee*. Bovine Leukosis Virus (BLV) is a retrovirus spread by blood transfer. This virus causes lymphosarcoma in approximately 5 percent of animals that test seropositive. Clinical signs are dependent on the organ that is affected but include chronic weight loss, posterior paresis, and abdominal tumors. In our study, samples were collected from 184 cattle from 5 herds across Weakley County, TN from April to September of 2022. Serum was sent to Kord Diagnostic Laboratory in Nashville and tested via BLV Antibody ELISA. Out of these samples, a total of 127 cattle tested positive for BLV with 57 negative results. Herd prevalence ranged from 19 percent to 98 percent positives with an average prevalence of 69 percent. This information will be used to help producers make culling decisions, educate producers on the outcomes of BLV, and establish a health program that reduces exposure to BLV in their herds.

**1-10** Case study of ceruminous gland adenocarcinoma in a 10-year-old spayed female cat. **Diana Watson, Amber Moore, Kelly Kennedy, and Zach Morphis**, *University of Tennessee at Martin, Martin, Tennessee*. While otitis is commonly found in cats, chronic otitis leading to malignancy is rare. In this case, a 10-year-old spayed female cat was treated for a chronic bacterial and fungal ear infection and ear mites. Despite treatment, the patient developed masses occluding both ear canals, causing discomfort leading to anorexia, depression, and behavior changes. Owners elected to humanely euthanize, and a necropsy was performed. Samples of lymph node, lung, and sections of ear masses were sent to Kord Animal Health Disease Diagnostics Laboratory. Histopathology found two concurrent pathologies: ceruminous gland adenocarcinomas and cystically dilated ceruminous glands. Research shows less than 2% of all neoplasia in cats is associated with ear canals. Inflammation may play a role in development of ceruminous gland adenocarcinomas, but more research is needed to determine its exact effect.

**1-11** Cercospora leaf spot resistance of crapemyrtle cultivars in Tennessee, USA. **Madhav Parajuli\*, Prabha Liyanapathirana, Jacob Shreckhise, Donna Fare, Benjamin Moore, and Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee (MP, PL, FBG), and U.S. Department of Agriculture, Agricultural Research Service, McMinnville, Tennessee (JS, DF, BM)*. To compare Cercospora leaf spot resistance, 32 crapemyrtle cultivars belonging to *Lagerstroemia indica*, *L. fauriei*, *L. indica* x *L. fauriei*, and *L. indica* x *L. fauriei* x *L. limii* and 12 cultivars or unnamed selections belonging to *L. indica*, *L. indica* x *L. fauriei*, *L. indica* x *L. fauriei* x *L. limii*, *L. limii*, and *L. subcostata* were planted in field plots in 2004 and 2011, respectively. The experiment was a completely randomized block design with three and four replications in the 2004 and 2011 plantings, respectively. Plants were evaluated for Cercospora leaf spot disease severity from Aug. to Oct. of 2015, 2016, and 2017. Cultivars Fantasy, Kiowa, Townhouse, Woodlander's Chocolate Soldier, Apalachee, and the *L. subcostata* and *L. limii* selections had lowest Cercospora leaf spot disease severity ratings. Cultivars Choctaw, Miami, Natchez, Osage, Sarah's Favorite, Tonto, Tuscarora, and Tuskegee, and Arapaho were moderately resistant to Cercospora leaf spot.

**1-12** Coffee chaff as an alternative substrate component for container-grown annuals. **Jacob Rawls\* and Anthony Witcher**, *Tennessee State University, Nashville, Tennessee*. Coffee chaff is the protective cover that surrounds coffee beans. Coffee chaff is a waste product of the coffee industry and could possibly be used to mitigate the use of peatmoss in container production. The objective was to evaluate coffee chaff as a substrate component for container-grown annuals. Marigold seedlings were grown in five substrates containing coffee chaff at 10%, 25%, and 50% mixed with pine bark and two standard substrates using two fertilizer rates. All plants grew well, height was similar for peatmoss and chaff (10 and 50%) substrates but shoot biomass was greatest for the peatmoss substrate. Substrates amended with chaff had a higher pH than standard substrates but pH decreased over time to an acceptable level. The low fertilizer rate resulted in larger plants compared to the high rate. In conclusion, coffee chaff could be used as a substrate component but needs to be researched further.

**1-13** Comparative analysis of biomass sorghum and energycane as a bioenergy feedstock production in the southeastern region. **Kabirat Nasiru\* and Prabodh Illukpitiya**, *Tennessee State University, Nashville, Tennessee*. The aim to meet energy demands and guarantee energy security in the U. S. promotes the need to research and use a diverse variety of alternative feedstock. This paper compares the profitability of biomass sorghum and energycane as a lignocellulosic feedstock for the bioenergy market in the southeastern region. Management information including site-specific input applications and associated input costs were collected from project sites in five states (Texas, Mississippi, Alabama, Florida, and Louisiana). We produced site-specific enterprise budgets to assess production costs in biomass sorghum and energy cane based on the input application. We performed Monte Carlo simulation to determine the potential range of net returns by analyzing unit costs of inputs, biomass yield of sorghum and energy cane, and dry matter price variations. The simulation results show the potential for profit from growing both feedstocks in the region depending on biomass yield and market prices.

**1-14** Comparative evaluation of treatments for the management of bacterial blight on lilac. **Prabha Liyanapathiranage, Cansu Oksel, Christina Jennings\*, Terri Simmons and Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Bacterial blight caused by *Pseudomonas syringae* *pv. syringae* (Pss) is a common and often serious disease of lilac (*Syringa reticulata*). This bacterium can spread to new susceptible plants via insect vectors, wind, rain and through contaminated tools, hence managing this disease is challenging. In this current study, lilac 'Ivory Silk' plants inoculated with ~107 CFU/ml of a bacterial suspension of Pss were subjected to different treatments and plants were evaluated weekly for bacterial blight, defoliation and phytotoxicity. The experiment was repeated in 2021 and 2022. Concluding disease severity values of the non-treated inoculated plants were 22.0% and 63.8% in the 2021 and 2022 experiments, respectively. Plants treated with Postiva, Proud 3, TDA-NC-1 (experimental product), Tril-21 and Triathlon showed the lowest disease severity. Phytotoxicity was not observed in any of the treated plants. Treatments identified in this study can be applied in a rotation program to manage bacterial blight on lilac.

**1-15** Controlling *Phytophthora capsici* in tomatoes using endophytic bacteria and analysis of their biocontrol mechanisms. **Jamille Robinson\*, Daniel Ambachew, Ethan Swiggert, and Margaret T. Mmbaga**, *Tennessee State University, Nashville, Tennessee*. were involved in promoting tomato plant growth in height, root length, weight, and chlorophyll content. The objective of this study was to analyze microbe-emitted volatile chemical compounds emitted by BCA's and P.cap. Preliminary studies show three BCA isolates were found to promote growth in tomatoes, and two were also found to influence plant protection. Additionally, certain P. Cap volatile compounds were no longer observed when BCA challenged, and new compounds were observed from the interactions. These results suggest that Plant growth-promoting rhizobacteria constitute an important component of biological control agents (BCA) for plant disease management to reduce synthetic pesticide inputs in crop production systems. This study compared the role of three Bacillus isolates in promoting plant growth and protection against *Phytophthora capsici* (P.cap) in tomatoes. Observations from previous studies indicated that volatile compounds interactions between volatile chemical compounds of BCA may be involved in P.cap pathogenesis and plant defense.

**1-16** Corn-based biorenewable fire logs. **John Cole and Victoria Holliday\***, *University of Tennessee at Martin, Martin, Tennessee*. This study aimed to develop a biorenewable fire log composed solely of corn and corn residue comparable to industry standard wood-based fire logs. Four fire logs varying in percent composition of stover and corn were manufactured using either a mechanical press or by a hand pressing process. Fabrication was accomplished without a wax binder and consisted solely of corn-based mixtures and water. Samples of each fire log were tested for their energy content using a bomb calorimeter. The energy content data was compared with industry-standard fire logs. Based on the energy content data collected, corn-based fire logs did not prove to be comparable in heating value and usability to traditionally manufactured wood fire logs.

**1-17** Creative solutions for demonstrating experiential learning through internships. **Jessica Crews-Garcia and Joey Mehlhorn**, *University of Tennessee at Martin, Martin, Tennessee*. It has long been understood that students gain from university sponsored internships as part of the college experience. Many programs across the country have encouraged or even required internships for graduation but there

is division on how best to assess the experience and document student outcomes. This can become more complicated when students are completing the experience in an online format. The University of Tennessee at Martin has required an internship experience as part of graduation requirements for agribusiness majors for the past 10 years. Several modes of assessment have been utilized with varying degrees of success. Methods that include student video or in-person presentation of experience have proven to work best, but the use of formalized documents to assess pre and post experiences have been shown to provide the clearest evidence of student growth through the process. This research will demonstrate best practices from our experience including successes and failures.

**1-18** Cryopreservation of microspores harvested at different developmental stages from sorghum varieties. **Sherod Mitchell, Aron Felts, and Ahmad. N. Aziz**, *Tennessee State University, Nashville, Tennessee*. Sorghum (*Sorghum bicolor*) is one of the largest multipurpose crops used for different societal purposes. Its genetic studies were facilitated by isolating developing microspores towards being cryopreserved. Five sorghum varieties, i.e., Dale, Dasht Local, Topper 76-6, Achi Turi, and Tx430 were grown in the field and greenhouse for yielding immature pollen. From mature plants, the panicles were harvested, and surface sterilized through a 7:3 diluted bleach solution. Then anthers were aseptically extracted and separated per their stage of being premature, semi-mature, or mature. In 1.5 ml labeled tubes 10-15 anthers for each stage were placed in 1.0 M mannitol to release microspores. The extracted microspores were concentrated by centrifugation before being cryopreserved. To preserve these living cells, extremely low temperatures were used, after pouring isopropyl around tubes containing microspores. These protocols helped to prevent cryo-damage to the cells and allowed microspores preservation over an extended period.

**1-19** Developing experiential learning opportunities through international travel study. **Joey Mehlhorn and Sandy Mehlhorn**, *University of Tennessee at Martin, Martin, Tennessee*. Opportunities for agriculture undergraduate students to travel internationally has been limited due to the COVID-19 pandemic in the past 2 years. Travel has increased since 2021, but it is still not as widely available as pre 2019 numbers. We have worked to bring back more international programs but are still facing resistance from students as concerns about health, cost of travel, and general burnout among college students. Discussion of planning, recruitment, and financing are critical to the success of any international trip. Results will share impacts from past trips and how they are used to plan and improve future travel opportunities and how travel studies can fit into the curriculum. A step-by-step process for organizing and assessing an effective travel study will be presented.

**1-20** Effect of fulvic acid on phytochemicals and antioxidant capacity of organic bell pepper grown in open-field conditions. **Pinky Kanabar\*, Ying Wu, and Dilip Nandwani**, *Tennessee State University, Nashville, Tennessee*. The study analyzed the effect of soil and foliar application of fulvic acid (FA) on phytochemicals and antioxidant properties of organically grown bell pepper variety Revolution at both the mature green and red stage. FA was applied as a soil drench and foliar spray at different rates (0, 0.3, 0.7, 1, 1.4 fl oz./gal). Total phenolic and total flavonoids compounds ranged from 2.58 to 3.58 mg GAE g<sup>-1</sup> d.w., and 10.39 to 15.62 mg CE g<sup>-1</sup> d. w. respectively. Both soil and foliar treatments showed no significant effect on antioxidant activity as determined by 2,2-diphenyl-1-picrylhydrazyl) reagent at green and red stages (DPPH, 88–92%). High reducing power capacity was possessed at both stages. Vitamin C levels ranged from 142.74 to 255.71 mg 100 g<sup>-1</sup> d. w. In conclusion, both soil and foliar treatments of FA enhanced the total phenol and flavonoid content, vitamin C and antioxidant activity of bell pepper.

**1-21** Efficacy evaluation of poultry water sanitizer products on foodborne pathogens. **Rabin Raut\*, Agnes Kilonzo, and Pramir Maharjan**, *Tennessee State University, Nashville, Tennessee*. Preharvest safety holds a greater significance in reducing the foodborne pathogens in poultry production that can be achieved through poultry drinking water sanitation. The ongoing study is conducted to evaluate the efficacy of poultry water sanitizer products on foodborne pathogens - *Salmonella*, *Listeria*, *Staphylococcus* and *E. coli* conducting series of in-vitro benchtop tests. An initial set of benchtop study was conducted to understand the efficacy of chlorine-based product (sodium hypochlorite, 8.25 %) against *Salmonella enteritidis* mimicking application rate of the product as used in field practice. The efficacy test showed that the product efficacy could be affected by pathogen load in water supplies. Other

sets of efficacy tests will be similarly performed for two commonly used sanitizer products based on hydrogen peroxide and quaternary ammonium compounds.

**1-22** Evaluation of fungicides for powdery mildew control of *Hydrangea macrophylla*. **Christina S. Jennings\***, **Terri Simmons**, **Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. Powdery mildew disease is an important disease of hydrangea in nursery production. The efficacy of fungicides against powdery mildew were assessed on *Hydrangea macrophylla* 'Nikko Blue'. Treatments were Postiva at three different rates and Mural. There were three application periods per treatment rate at 2, 4, and 6 weeks. Powdery mildew severity was determined by percentage of foliage affected. All treatments significantly reduced disease severity and disease progress (AUDPC) compared to the non-treated control hydrangea plants. All three rates of Postiva and Mural treatments at the 2 and 4-week intervals had the lowest disease severity and AUDPC.

**1-23** Evaluation of perennial sorghum's applicability as a flavoring grain in liquor production. **Harris Smith\***, **D. Sterling Rodgers\***, **T. Garrett Justice\***, **Pheonah Nabukalu**, **Tony V. Johnston**, **Song Cui**, **Samuel Haruna**, and **Seockmo Ku**, *Middle Tennessee State University, Murfreesboro, Tennessee (HS, DSR, TGJ, TVG, SC, SH, SK), and The Land Institute, Selina, KS (PN)*. A perennial sorghum hybrid derived from *Sorghum bicolor* and *Sorghum halepense* has been recently developed to reduce and reverse soil degradation in grain sorghum-growing regions. The price of sorghum per bushel is comparable to that of well-known cereals like corn, rye, wheat, and barley. Cereal grains, such as this hybrid, are commonly used in a variety of fermentation processes, including but not limited to sake and spirits production. Although sorghum has been around for centuries, research on perennial strains is relatively new and limited in scope. For this perennial sorghum hybrid to gain traction in mainstream markets, it must be used in a variety of products. The goal of this research is to find a viable way to use the new perennial sorghum hybrid in various liquor categories by mimicking typical bourbon, whiskey, and vodka grain bills and production techniques. This would broaden its application beyond animal feed and biofuel.

**1-24** Extraction efficiency of goldenseal (*Hydrastis canadensis* L.) using different solvents and plant tissues. **Kaela Wolkiewicz**, **Ethan Swiggart**, **Ying Gao**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Goldenseal (*Hydrastis canadensis* L., Ranunculaceae) is a medicinal plant grown in eastern North American forestlands. The roots and rhizomes of Goldenseal are known for their antimicrobial properties. The antimicrobial property of goldenseal has been reported to be attributed to three major alkaloids: berberine, hydrastine, and canadine. Recently, attention has been paid to the exploitation of botanical pesticides for crop protection. The development of alternative control strategies using botanicals not only reduces dependency on synthetic fungicides but is also eco-friendly to the environment. Because of the anti-antimicrobial property of goldenseal, its extract became a promising alternative as a botanical pesticide. Our goal of this study is to compare the extraction efficiency of goldenseal using different solvents and different parts of the plant. This study will lead to the development of goldenseal extract as a botanical pesticide for organically controlling plant pathogens.

**1-25** HBCU agriculture graduate school decision. **Tanya McNeal**, *Tennessee State University, Nashville, Tennessee*. Education is for improving the lives of others and for leaving our community and world better than how we found it. Students have several opportunities to continue their education throughout their lifetime. From elementary school to middle school to high school, all the way to college. Collegiate education can vary in many shapes and many forms. As undergraduate students begin to matriculate through their university and program of study, scholars must decide if they would like to further their education upon the completion of undergraduate. We propose to analyze the benefits and drawbacks of attending the top 12 HBCU-ranked agricultural graduate programs. Graduation rate, program diversity, agricultural education objectives, cost, and program curriculum will be analyzed. If we analyze the benefits and drawbacks of the HBCU Agriculture Programs, then a current undergraduate student will have more knowledge and a better understanding of which HBCU graduate program aligns with them.

**1-26** Herbicide resistance based eco-types of pigweed and Johnson grass in Tennessee. **Rafeq Jambi**, **D Yahya**, **Aron Felts**, **Ahmed Aziz**, *Tennessee State University, Nashville, Tennessee*. Despite the development of herbicide management measures in the past, weed resistance to single or multiple types

are currently the biggest concern. Amaranth and Johnson grass weeds are becoming more active and resistant to herbicides, posing a danger to global food security. To effectively control these weeds, it may be very helpful to develop understanding of their multiple resistance mechanisms. The intricate process for this adaptive trait, would require to identify major metabolic routes and mechanisms for resistance to glyphosate and acetolactate synthase. Therefore, three sorghum and amaranth plant samples were collected each from 36 counties 12 in west, 9 in east and 15 in middle Tennessee. Herbicides Round-up, Duracore, and Sharpen were reported to be used on some of these collections. Currently DNA samples are extracted from each accession and quantified given average uv230/260 ratio of 1.5 and 36.24 ng/ $\mu$ . Yields toward subsequent genetic analyses.

**1-27** Identification and evaluation of repellent compounds for the management of ambrosia beetles. **Anju Poudel\***, **Jason B. Oliver**, **Cynthia Perkovich**, **Paul A. O'Neal**, **Agenor Mafra-Neto**, **Jesse Saroli**, **Karla M Adesso**, *Tennessee State University (AP, JBO, PAO, KMA), McMinnville, Tennessee, Ashland University (CP), Ashland, Ohio, and ISCA Inc (AM-N, JS), Riverside, California.* To reduce Ambrosia beetles (Coleoptera: Scolytidae) (ABs) pressure on nursery trees, we investigated previously reported repellents with ethanol-baited bolts to assess their efficacy. First, we used an ethanol-baited dowel with repellent. Treatments: cedarwood oil (CO<sub>2</sub>-derived), 2-butoxyethanol, 2-ethyl-1-hexanol, Beetle Guard (BG), and untreated control. Second, we assessed the ability of the BG to repel ABs from ethanol-baited dogwood *Cornus florida* bolts at increasing rates of ethanol emission (low, medium, high). Finally, we assessed the effective distance of BG efficacy with ethanol-soaked bolts placed at increasing orders of 0.5 m intervals. Bolts were arranged in a randomized complete block design in the field. BG repelled the ABs attacks more compared to other tested repellents and similarly in different ethanol release rates. However, no difference in BG repellence was detected between the different distance treatments. Our findings suggest that repellent technologies may be useful for reducing AB attacks on stressed trees.

**1-28** Implementation of supplemental instruction in Farm Animal Health course. **Montana Wright\***, **Diana Watson**, and **Sandy Mehlhorn**, *University of Tennessee at Martin, Martin, Tennessee.* Historically, the animal science upper division course, Farm Animal Health, has been challenging for students. This course has no prerequisites and has been popular among all agricultural majors. Previously, a study was undertaken to try and determine factors to student success in this course. The study proved inconclusive, but the need remained to improve student success and comprehension of material. Based on the recent success with the implementation of supplemental instruction in another upper division animal science course, it was decided to implement supplemental instruction in this course as well. A secondary benefit to this implementation is that it allows undergraduate students the opportunity to explore teaching as a career path and to develop useful teaching strategies and techniques. Tracking of student participation in supplemental instruction sessions, evaluation of the supplemental instruction experience, and overall grade averages will be observed to determine the success of this program.

**1-29** Pathogenicity of fungal and bacterial species associated with American ginseng (*Panax quinquefolius*). **Prabha Liyanapathirana**, **Farhat A. Avin**, **Cansu Oksel**, **Ethan Swiggart**, **Ying Gao**, **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, TN, (PL, FA, CO, FBG), and Middle Tennessee State University, Murfreesboro, TN (ES, YG).* American ginseng (*Panax quinquefolius* L.) is one of the most valuable medicinal plants that are native to the United States. These plants are often naturally growing under hardwood canopies or cultivated in fields covered with artificial shade. This slow-growing plant is susceptible to a variety of fungal and bacterial pathogens. In this study, cultivated and wild American ginseng plants exhibiting disease symptoms on above and below-ground parts were collected from Rutherford County in Tennessee and Garrett County in Maryland and processed to identify the potential causal agents. Colony morphology, microscopy, biochemical tests, pathogenicity test and molecular techniques were used to confirm the pathogen identity. *Erysiphe heraclei*, *Alternaria alternata*, *Pestalotiopsis nanjingensis*, and *Pseudomonas marginalis* were identified as the causal agents of the powdery mildew, leaf blight, leaf spots, and rusty root diseases, respectively. Identification of pathogens that can infect American ginseng plants is crucial in the management of the diseases.

**1-30** Quantification of kefir production in milk and whey. **Selena Casey\*, Yelyzaveta Zuy\*, and Keely O'Brien**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Kefiran is an exopolysaccharide produced by kefir grains during milk fermentation. With recent concerns about growing plastic pollution, this biopolymer has received notable attention as a biodegradable film-forming agent used for food packaging. Despite the growing body of research in kefir applications, various production challenges make large-scale manufacturing expensive and labor-intensive. The goal of this project was to determine the feasibility of using more cost-effective substrates for kefir production. Four substrates were used in a 48-hour fermentation: neutral whey, acidified whey, cultured whey, and whole milk. Fermentation was followed by the extraction of kefir. It was found that grains grown in neutral whey produced the highest amount of kefir, while milk resulted in the lowest kefir yield. These results indicate that substrates that are considered industrial wastes can be feasible alternatives to milk for kefir production. Further investigation is needed to examine the properties of kefir produced from different substrates.

**1-31** Quantification of losses to top five: Assessment of the impact of pandemic to most important farm production sectors in Tennessee. **Satya Tiwari\*, Prabodh Illukpitiya, and Devashish Bhandari\***, *Tennessee State University, Nashville, Tennessee*. According to the National Agricultural Statistics Service (NASS), Tennessee ranks eighth in the number of farms, and the state's number one commodity in terms of cash receipts is cattle and calves, followed by soybeans, broilers, nursery crops and corn. In 2020, the state generated around \$3.7 billion in agricultural cash receipts. Given the importance of farming sector to the state economy, the objective of this paper is to estimate the economic impact of the pandemic to top five receipts generating agricultural industries to Tennessee economy. Using IMPLAN input-output model, we generated the total economic impact to the state economy. Further we aggregated the counties and performed the analysis for east, middle and west Tennessee regions to better understand the local effects of the pandemic to the above sectors. The estimated results shows a considerable loss of revenue, employment and value added to the local economy.

**1- 32** foodborne pathogen detection via tangential flow nano/microfilter bioseparation system. **Weston Williams\*, Doofan Eke\*, Jordan Jungen\*, Anna Arnold\*, Samuel Haruna, Ying Gao, Keely O'Brien, Tony V. Johnston, Mary B. Farone and Seockmo Ku**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Early detection of pathogens is essential for reducing the incidence of foodborne illness. The most rapid USDA/FDA/ISO approved detection protocols for the detection of *Salmonella*, *E. coli* and *Listeria* spp. require 1-3 days to complete. The goal of this research is to develop a novel hydrophilic nano/micro membrane-based microbial bioseparation protocol that shortens the detection time of target microorganisms and increases the sensitivity of the test to levels currently only possible via PCR and immunosensing detection methods. The proposed protocol is targeted to detect food-borne pathogens in less than 10 hours and have the sensitivity to detect 1 CFU/g of target bacteria. Reducing testing time and sensitivity to these levels has the potential to significantly reduce food poisoning cases and improve consumer health.

**1-33** Role of mannitol content in the pathogenicity of *Fusarium oxysporum* in hydrangea. **Sandhya Neupane\* and Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. Fifteen hydrangea cultivars were either inoculated or non-inoculated with *Fusarium oxysporum*, analyzed for root rot severity and mannitol content in roots after 4 months. Dried root powder (0.5 g) was extracted twice with 10 mL boiling distilled water and adjusted to 25 ml volume. In 1 mL extract, sodium periodate (1 mL), rhamnose (2 mL) and Nash reagent (4 mL) was added and then placed in a water bath for 15 mins. Absorbance at 412 nm was measured in spectrophotometer using 96 well plates and mannitol content ( $\mu\text{g/mL}$ ) was calculated using linear regression equation created from standard curve. Mannitol content was high in all inoculated plants compared to the non-inoculated plants. Mannitol content and root rot severity in inoculated plants was highest in cultivars such as Back Porch, Harmony, Munchkin, Queen of Hearts, Snow Giant and Pee Wee (*quercifolia*) indicating the role of mannitol in pathogenicity of *F. oxysporum*.

**1-34** Screening and response of five commercially available cowpea *Vigna unguiculata* cultivars to low pH and aluminum toxic conditions. **Max C. Miller II\* and Matthew W. Blair**, *Tennessee State University, Nashville, Tennessee*. Aluminum toxicity tolerance in crops is an important aspect of sustainability for areas with low pH soils. Seedlings from total of five commercially available cowpea cultivars were

screened for their aluminum toxicity response under hydroponic conditions. Three treatments included a 0.5 mM CaCl<sub>2</sub> solution at pH 5.5-5.8, a 0.5 mM CaCl<sub>2</sub> solution at pH 4.3, and a 0.5 mM CaCl<sub>2</sub> solution at pH 4.3 with 50 μM AlCl<sub>3</sub>. Primary root length measurements were taken at 0, 24 and 48 hours after treatments began. Results show hydroponic systems are useful for screening cowpea under aluminum toxic conditions, as all cultivars showed reduced primary growth rates when treated with 50 μM AlCl<sub>3</sub>. However, low pH conditions may confound changes in apparent root growth rates. Identifying cultivars that are insensitive to low pH conditions with differential responses to aluminum toxicity for comparison should be prioritized in future screenings.

**1-35** Supply chain disruptions: Examining the impact of Covid-19 on food processing and manufacturing industries in Tennessee. **Devashish Bhandari\***, **Prabodh Illukpitiya**, and **Satya Tiwari\***, *Tennessee State University, Nashville, Tennessee*. The value of Tennessee's agricultural production and processing industries accounted for nearly 5 percent of the state's GDP in 2020. The revenue generated in agri-food industries brings additional revenue through re-investment within the economy, causing multiplier effects. However, the Covid-19 pandemic caused significant disruptions to the agricultural food supply chain in 2020. The study was conducted to analyze the total economic impact of the pandemic on the agri-food sector in Tennessee. The 20 food processing and manufacturing industries were selected and categorized into four groups: plant-based, dairy, poultry, and seafood. The input-output model was employed to obtain the total economic impact. The direct, indirect, and induced impacts on the revenue, employment, and value-addition sectors were estimated based on the above-referenced groups. The results showed that Covid-19 had a considerable negative impact on Tennessee's food processing and manufacturing industries.

**1-36** Understanding the effects of chlorine residue residuals on nutrient digestibility and performance parameters of broiler chickens. **Alexis McDade\***, **Rabin Raut\***, **Morgan Roberts\***, **Thyneice Brown**, and **Pramir Maharjan**, *Tennessee State University, Nashville, Tennessee*. The impact of chlorine residual in poultry water supplies on nutrient digestibility is unknown, even though chlorine is used as a standard drinking water sanitizer. A bird trial will be performed to understand the effects of chronic exposure of chlorine residuals in water on broiler performance. Three different levels of chlorine added to drinking water to reach residual target concentrations of < 1ppm, 2-5 ppm, and >10 ppm will act as treatments. The birds with no chlorine added will act as the control. Birds will be fed treatment water for 21 days, and ileal digesta will be collected to understand amino acid digestibility. Feed efficiency will also be measured. The outcome of this project will help determine the maximum allowable chlorine levels in water without affecting nutrient digestibility.

**1-37** Use of flowering plants for arthropod pest management. **Kaushalya G. Amarasekare**, **Firuz Yuldashev**, and **Yuna Gaire**, *Tennessee State University, Nashville, Tennessee*. Crop damage due to arthropod pests is one of the most critical problems growers face in agricultural cropping systems. To combat pests, growers use various management practices, like physical, cultural, biological, and chemical, or combinations of these methods. Integrated pest management (IPM) is an environmentally sustainable practice that combines all possible management techniques. The use of beneficial arthropods, such as natural enemies of pests, helps manage pests without using harmful pesticides. Information on using flowering plants as an IPM technique to attract natural enemies is limited. This study used three flowering plants to attract natural enemies to a tomato crop. We used zinnia, marigold, and Rudbeckia in a replicated field study conducted in 2020 and 2021 in Tennessee. Our results show that zinnia, marigold, and Rudbeckia attract predatory arthropods, such as syrphids, ladybeetles, and *Orius* sp. We discuss the effects of flowering plants in attracting natural enemies in crop fields.

**1-38** Utilizing consumer preferences in beef consumption and labeling to improve consumer knowledge. **Madison Smith\***, **Ross Pruitt**, and **Todd Winters**, *The University of Tennessee at Martin, Martin, Tennessee*. There is a known disconnect between producers and consumers of the agriculture industry, but in the age of social media, the beef industry especially has been singled out by the media calling for changes. The basis of this project and survey was to ascertain the specific types of information beef consumers want on their labels, how important certain designations are, and if they would pay a premium for beef with more in-depth labeling. A total of 137 surveys were collected on paper at a farmer's market and at a farm-to-table restaurant in Northeast Tennessee. The surveys evaluated demographics,



frequency of beef consumption, and Likert scales on the importance of six categories in labeling. The goal of this project was to determine how beef producers could successfully market their products with the desired labeling information and how producers can educate consumers about the different designations.

**1-39** Weed emergence in soybean straw residue and poultry litter. **Gracie L. Carmon\***, **Craig S. Darroch**, **Bethany R. Wolters**, and **Barbara A. Darroch**, *University of Tennessee-Martin, Martin, Tennessee*. The objective of this study was to determine weed emergence in soybean residue (SBR) used for poultry litter (PL). Finding alternative uses for crop byproducts such as SBR can improve sustainability of production. Poultry litter is returned to the field as a source of nutrients, but producers have concerns about weed seeds in crop residues used as litter material. To test for weed seed emergence, five treatments consisted of 4L trays containing potting soil alone, SBR, SBR-PL, 50/50 mixtures of soil + SBR and soil + SBR-PL. Six replicates were set up in a greenhouse using a RCB design. Trays were visually checked for weed emergence over a period of 48 days. Soil alone had the highest emergence of 1.3 seedlings per tray, SBR treatments averaged 0.8 seedlings per tray, and SBR-PL treatments averaged 0.3 seedlings per tray. Low seed emergence indicates SBR could be used as poultry litter.

**1-40** Potential role of mulches and planting time in managing southern blight and enhancing cannabinoid production in floral hemp in Tennessee. **Sai Suvindh Maddela\*** and **Emmanuel Chiwo Omondi**, *Tennessee State University, Nashville, Tennessee*. Removal of industrial hemp [with less than 0.3% total tetrahydrocannabinol (THC)] from the Schedule 1 list of controlled substances in the 2018 Farm Bill resulted in a great resurgence in its cultivation. Since hemp has not been grown in the U.S. for about 80 years, knowledge needed to grow it has largely been lost. Some of the greatest challenges hemp farmers face are pests and diseases given limited pesticides available for hemp. Southern blight (*Sclerotium rolfsii*) is a prevalent fungal disease favored by the hot and humid climatic conditions prevalent in southeastern states. Black plastic mulch favored by vegetable and floral hemp growers to control weeds exacerbates these conditions. The role of straw mulch (known to reduce high soil temperatures) and time of planting in disease management has not been established. This study evaluates effects of black plastic, straw mulch and time of planting on southern blight, THC and hemp production.

## Botany Posters

**2-01** An investigation into light availability across the range of *Physaria globosa*. **Emily Powell\***, **Shawn Krosnick**, and **Peter Li**, *Tennessee Tech University, Cookeville, Tennessee*. *Physaria globosa* (Brassicaceae) (Desv.) O'Kane & Al-Shehbaz (Short's bladderpod) is a federally endangered species listed as globally imperiled and limited to just 33 populations across Tennessee, Kentucky, and Indiana. Essential habitat for *P. globosa* includes south-to-west-facing steep hillsides or bluffs with calcareous outcrops and shallow or rocky well-drained soils. The most robust and stable populations occupy sites with high light availability due to restricted development of midstory and forest canopy vegetation. Overstory shading has been documented as a contributing factor to the extirpation of several occurrences throughout the range of *P. globosa* and remains a limiting factor at extant occurrences. In both 2021 and 2022, five occurrences were sampled to investigate limitations of the reproductive biology across the range of *P. globosa*. Lidar data is being used and analyzed in ArcGISPro to inform canopy openness at each of the five occurrences to contribute to a greater understanding of how this impacts *P. globosa* fecundity.

## Cell & Molecular Biology Posters (7 posters, missing 5)

**3-01** Influence of citric acid on the boron adsorption on oxide minerals: A macroscopic and in situ ATR-FTIR study. **Avedananda Ray\***, **Sudipta Rakshit**, **Jerzy Mierzwa**, and **Dafeng Hui**, *Tennessee State*

*University, Nashville, Tennessee.* Citric acid is a major organic ligand ubiquitously present in the soil. The presence of citric acid may influence the metal chelation and availability of plant micronutrients (such as Boron) through competitive retention mechanisms on soils. Here we propose to investigate the competitive retention mechanism of boron (B) and citric acid on iron oxide minerals (Hematite) using macroscopic sorption studies, and in situ ATR-FTIR spectroscopic probes to understand the surface interaction mechanisms under a range of solution properties. Preliminary results suggested that hematite have higher affinity for citric acid and B retention on hematite was influenced in the presence of citric acid. In situ ATR-FTIR results revealed the change of surface complexation mechanism of Boron in the presence of citrate.

**3-02** Isoform-specific role of Glycogen Synthase Kinase-3 in obesity-induced glucose intolerance. **Jacob J. Lemon\***, **Prachi Umbarkar**, **Sultan Tousif**, **Manisha Gupte**, and **Hind Lal**, *Austin Peay State University, Clarksville, Tennessee (JLL, MG), and University of Alabama, Birmingham, Alabama (PU, ST, HL).* Obesity-associated metabolic disorders are rising at pandemic proportions; hence, there is an urgent need to identify underlying molecular mechanisms as potential therapeutic targets against obesity-associated perturbations. Glycogen Synthase Kinase-3 (GSK-3), an enzyme with two isoforms (GSK-3 $\alpha$ / $\beta$ ), is highly implicated in metabolic diseases, including obesity-induced glucose intolerance. In the present study, we investigated the isoform-specific role of GSK-3s in glucose metabolism in high-fat diet-induced obesity. Control and GSK-3 $\alpha$ /GSK-3 $\beta$  heterozygous mice were fed a high-fat diet for sixteen weeks. After four weeks of high-fat feeding, GSK-3 $\beta$  inhibition improved glucose clearance in GSK-3 $\beta$  heterozygous mice, but chronic high-fat feeding blunted this protective effect when GSK-3 $\beta$  heterozygous mice gained significantly higher body weight (fat mass) compared to the controls. In contrast, GSK-3 $\alpha$  inhibition did not affect glucose clearance. These results suggest that GSK-3 $\beta$  is the dominant isoform in glucose regulation in obesity-induced glucose intolerance and nutritionally regulated by high-fat feeding in a weight-dependent manner.

## Chemistry Posters

**4-01** Characterization of binding-induced conformational changes of arrestin-3 Using 19F-nmr. **James Dethero-London\***, **Brian Chong\***, **Xuanzhi Zhan**, and **William Carroll**, *Tennessee Tech University, Cookeville, Tennessee.* Arrestins, a small family of multi-functional scaffold proteins, play essential roles in G-protein coupled receptor (GPCR) signaling. Due to the many signaling pathways they are involved in, understanding arrestin structure and dynamics could be important for developing therapeutics for a variety of diseases such as Alzheimer's and Parkinson's. This project seeks to better elucidate the mechanisms through which arrestin-3 mediates these signaling pathways with the use of 19F Nuclear Magnetic Resonance (NMR) spectroscopy analysis of interactions and conformational changes associated with binding known partners such as IP6 and kinases from JNK cascades, including ASK1, MKK4 & 7 and JNK3. We employ two different methods for 19F incorporation into arrestin-3: (1) unnatural amino acid (F-Trp) incorporation and (2) specific labeling on cysteine residues.

**4-02** Comparison of thermally-evaporated and spin-coated ge-based chalcogenide glass thin films. **Peyton Simpson\***, **Destiny Mathews\***, **Carry Brennan**, **Jiri Jancalek**, **Stanislav Slang**, **Miroslav Vleck**, *Austin Peay State University, Clarksville, Tennessee (PS, DM, AK, CB), and University of Pardubice, Pardubice, Czechia (SS, MV).* The use of solution-based techniques to produce chalcogenide films with controlled sensitivity to exposure with UV and visible light is very promising. This method allows producing thin films with distinct optical properties and chemical compositions. Films made using both solution and non-solution-based techniques were prepared in order to compare their optical properties and structural differences. Exposure by wide spectrum halogen lamp was used to study light-induced effects in the prepared thin films. Applicability of thermally evaporated and spin-coated thin films for wet lithographic processes was studied.

**4-03** Computational docking of the N-Terminal sequence of JNK3 with Arrestin-3. **Trenton Martin**; **Xuanzhi Zhan**, **Derek J. Cashman**, *Tennessee Technological University, Cookeville, Tennessee.* The N-

terminal region of the c-Jun amino-terminal kinase 3 (JNK3) is believed to be important binding interactions with the scaffold protein arrestin-3. An understanding of these interactions is essential for understanding signal transduction in cells. To study how JNK3 may interact, a 20-residue segment of the N-terminal sequence of JNK3 was docked into arrestin-3 using ClusPro. Thirty potential docked conformations were identified, and the frequency of occurrence of each amino acid residue in the binding site was determined. Analysis of these residues indicate four distinct regions in arrestin-3 that are likely binding sites for JNK3. Residues in contact are also predominantly hydrophobic, indicating the a plausible nature of proposed docking sites for JNK3 and arrestin-3. Molecular dynamics simulations of the N-terminal sequence of JNK3 suggests that these sites are plausible for binding.

**4-04** Derivatization methods for perfluoroalkyl substances (PFAS) by gas chromatography/tandem mass spectrometry (GC-MS/MS). **Clement Aruada\***, **Andrew Callender**, *Tennessee Technological University, Cookeville TN*. The perfluoroalkyl substances (PFAS) are environmentally persistent, non-degradable, bioaccumulative, and potentially harmful. These “forever chemicals” are widely distributed across the globe, and methods are needed for the rapid and routine analysis in a variety of matrices. Gas chromatography with mass spectrometry (GC/MS) is commonly used for the analysis of water samples, but PFAS compounds pose special problems in sample pretreatment, separation, and detection. Here, we present our work towards a sensitive, simple, and reliable analytical technique for the determination of perfluorocarboxylic acids (PFCAs) by GC-MS/MS. We compare the performance of two derivatization methods – esterification with isobutyl chloroformate (IBCF) and amidation with 2,4-difluoroaniline (DFA) - and report optimized conditions for the derivatization reactions, as well as their GC retention properties and characteristic mass spectrometric fragments. The overall instrument detection limit is determined from a calibration curve study, and found to be acceptable for the analysis of surface water samples following appropriate enrichment by solid-phase extraction (SPE), dispersive liquid-liquid microextraction (DLLME) and derivatization.

**4-05** Geochemical fingerprinting of natural waters in middle tennessee. **Bryant Davis and Andrew Callender**, *Tennessee Tech University, Cookeville, Tennessee*. Geochemical fingerprinting is an analysis of the chemical species, present within natural waters, to determine both the source and alteration of these systems. These chemical fingerprints are defined as specific patterns of analytes unique to each body of water. This research examines the presence of metals in surface waters that are located on two distinct physiographic regions of Tennessee: the Highland Rim and the Cumberland Plateau. Water bodies from these regions were chosen due to differences in local geology and land use patterns that each respective system are subjected to. Grab samples were obtained from various locations in order to obtain a true identity of each respective system. Multivariate analysis of variance (MANOVA) was then utilized to determine ratios of analytes so that a comparative analysis could then be performed. The obtained correlation coefficients should indicate how local geology and land use patterns affect the chemical identity of natural waters within Middle Tennessee.

**4-06** Identification of binding surface of kinase components on a peptide scaffold. **Brian Chong\***, **Sekyere Boateng\***, **Xuanzhi Zhan**, *Tennessee Technological University, Cookeville, Tennessee*. JNK3 is a member of Mitogen-Activated Protein kinases (MAPk), which controls many signal transduction cascades related to apoptosis and various diseases such as Parkinson’s and Alzheimer’s. The goal of this research is to investigate the structural basis of the novel ASK1-JNK3 interaction. NJ40 and related fragments from the N-terminus of JNK3 will be used to determine the critical amino acids comprising the JNK3-ASK1 interface. Characterization of the mini-scaffolding interface between NJ40-ASK1 will be done using SPR and pulldown assays. Mutagenesis of amino acids at the interface will be carried out to verify results. This research seeks to verify results using an in vivo assay to test the mini-scaffolding ability and biphasic inhibition of NJ40 fragments. Allosteric regulation of this system using ATP, IP6, and other binding partners will also be investigated.

**4-07** Probing the composition of melamine-oxalic crystals by raman microscopy and thermogravimetric analysis. **Mina K. Abdulkareem\***, **Beng G. Ooi**, **Dwight Patterson**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Melamine is found in many households, schools, canteen, and hospital objects. Food contaminated with melamine can potentially cause renal problems or formation of bladder and kidney stones since melamine-cyanuric complexes have been reported to cause renal tubule

blockage. In this study, Raman microscopy and thermogravimetric analysis were used to determine the composition of melamine-oxalate crystals formed in the presence of physiological components such as uric acid, L-cystine, urea, and creatinine. Crystals were made in water and artificial urine with melamine and oxalic acid at molar ratio of 1:10 together with a third physiological component. The formation of melamine crystals in water and artificial urine suggests that melamine can interact with physiological components to form crystals in bladder and kidney when ingested.

**4-08** The major impacts of human life due to chemicals used in hydraulic fracking. **Shiraz S. Ibrahim, Sujata Guha, Ryan Beni**, *Tennessee State University, Nashville, Tennessee*. The purpose of this research is to expose the socioeconomic and health effects of hydraulic fracking. The outlook of the future caused by fracking, the chemicals that are used and how it is affecting the health of workers as well as lower income communities are investigated. The different methods of fracking and the direct correlation of what is used and the differences between the results in different communities were also studied in this research. Chemicals such as methanol, ethylene glycol, and propargyl alcohol along with other chemicals which are mostly hazardous to human are used in fracking. Groundwater contamination, air pollution, and greenhouse emissions are only some of the negative effects of fracking. In this research we examined the effects of some chemical and geological backgrounds to take an in depth look at the pros and cons of hydraulic fracking development in lower income and minority communities.

## Ecology & Environmental Science Posters

**5-01** Assessing forest productivity in reclaimed mined sites in Kentucky's Appalachian region. **Nirmal Thapa\***, **Bishwa Acharya, Buddhi Gyawali, and Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee (NT, BP); Earth Mapping International, Inc. Norcross, Georgia (BA) and Kentucky State University, Frankfort, Kentucky (BG)*. The Appalachian region of Kentucky has experienced a significant landscape change over the past few decades due to surface mining. The Mountain Top Removal is the prevalent type of coal mining out of approximately 7,727 (active and inactive) mines in the seven-county study area. The removal of top surfaces impacted microclimate variations in the local region inducing changes such as vegetation structure and composition. The main objective of the study was to assess impacts of such activities on forest productivity over time. We hypothesized that the aboveground biomass productivity is associated with landscapes, and vegetation growth and composition. The study aimed to utilize time series analysis using GIS and Remote Sensing data from six different periods paired with forest inventory and analysis (FIA) data to estimate aboveground biomass and forest productivity in pre-mined, mined, and reclaimed sites. Assessing aboveground forest biomass is also important from the perspective of environmental sustainability.

**5-02** Comparison of microbial DNA extraction methods of *Rhizoctonia* spp. from symptomatic plant tissues for qPCR confirmation. **Pratima Subedi\***, **Madhav Parajuli\***, **Farhat A. Avin, and Fulya Baysal-Gurel**, *Tennessee State University, Nashville, Tennessee*. The first and most important step of molecular diagnosis is the isolation of high-quality and standard quantities of DNA. Microbial DNA extraction using commercial kits is a commonly used method, however, they are either expensive or have a supply shortage. Microbial DNA extraction of *Rhizoctonia* spp. from plant tissue using manual method is little explored and is inefficient. A manual procedure was tested for high-throughput microbial DNA extraction of *Rhizoctonia* spp. from symptomatic redbud plant tissues and deployed by quantitative PCR (qPCR) for confirmation. In the tested protocol, fifty mg of symptomatic plant tissue was enough to extract quality DNA that is comparable to a commercial microbial kit. The DNA so acquired was subjected to qPCR using specific primer pairs and compared to the DNA extracted using a microbial DNA extraction kit. The result of this study confirmed that this method can produce high-quality and quantity microbial DNA.

**5-03** Effects of the COVID-19 pandemic on public visitation levels in the Tennessee State Park system. **Matthew Boyd\***, and **Peter Li**, *Tennessee Technological University, Cookeville, Tennessee*. This project will cover the number of visitors to Tennessee State Parks in periods before, during, and after the Coronavirus pandemic restrictions to see their effect on visitation rates. We will use Tennessee State

Parks visitor data, Coronavirus data from CDC guidelines, and other sources to construct a timeline of the impact these events had on the Tennessee State Park system. The ultimate goal of this project is to show overarching trends of public behavior from the COVID-19 pandemic, through the lens of the Parks system of Tennessee.

**5-04** Evaluating the efficacy of a non-invasive hair sampling method for bobcat (*Lynx rufus*) research. **Emily Boring \***, and **LaRoy Brandt**, *Lincoln Memorial University, Harrogate, Tennessee*. The objective of this project was to examine how effective a hair sampling method is in relation to bobcat, *Lynx rufus*, research. Four traps were constructed and placed in four different locations throughout Lincoln Memorial University along with trail cameras. The traps were constructed from plywood to create a tent-like shape with carpet squares placed along the inside to be soaked with scent-lure (bobcat urine) as well as four gun-brushes per trap to catch any hair. The scent-lure is there to attract the bobcat, enticing them to move through the trap where their hair will catch in the gun-brushes. More research is required, but there was photographic evidence of a bobcat interacting with one of the traps and hair was extracted from every trap consistently. Based on the information we currently have compiled; it seems that these hair traps could be viable options for future bobcat research projects.

**5-05** Flowering and seed production of eelgrass (*Zostera marina*) in the South Slough and Coos estuary, OR. **Chloe E. Cummins\*** and **Ali R. Helms**, *University of Tennessee Southern, Pulaski, Tennessee (CC), and South Slough National Estuarine Research Reserve, Charleston, Oregon (AH)*. Since 2015, eelgrass (*Zostera marina*) populations throughout the South Slough estuary have considerably declined; therefore, understanding the flowering and seed dynamics of this area is crucial for planning restoration efforts. Our study's purpose was to determine flowering shoot density, timing of reproductive shoot development, and characteristics of mature seeds for both the South Slough and nearby Coos Bay estuary. We used 0.25 m<sup>2</sup> quadrats to measure density, and we collected flowering shoots from the field to assess reproductive shoot development and to collect mature seeds. Flowering shoot densities revealed that sexual reproductive capacity was generally low at most sites in both estuaries, and Fossil Point and Clam Island in the lower Coos estuary were identified as potential donor sites for seed-based restoration efforts based on shoot densities and average seed size. The knowledge gained from this study will better inform the implementation of seed-based restoration in the South Slough estuary.

**5-06** Germination of *Eragrostis elliotii* and *Aristida purpurascens* seeds after repeated exposure to smoke-infused water. **Kurt M. Brandt\*** and **Lisa M. Krueger**, *University of Tennessee at Martin, Martin, Tennessee*. Southern Florida's Pine Rocklands are endangered habitats mostly lost to development that also prevents regular burning necessary to maintain the few remaining fragments. Seeds or soil could be treated with smoke-water solution to supplement typical fires in these rocklands. Smoke-water contains karrikinolide, a germination enhancer, and trimethylbutenolide, a germination inhibitor. Different plants were expected to respond differently to various solution concentrations. We examined the effects of smoke-water concentration and application frequency on seeds of two Pine Rockland understory species, *Eragrostis elliotii* and *Aristida purpurascens*. Concentration had a significant effect on germination success, whereas application frequency did not. *A. purpurascens* germination was increasingly inhibited as concentration increased. *E. elliotii* seeds germinated best when treated with 40% smoke solution. Depending on species, a concentration between 20-40% could effectively enhance germination without significant inhibition. A solution of this strength may be useful for large scale application to Pine Rockland habitats.

**5-07** Impact of variations in moisture availability on myxomycete moist chamber results. **Lydia C. Thurman**, and **Adam W. Rollins**, *Lincoln Memorial University, Harrogate, Tennessee*. As the literature on myxomycetes expands, more questions pertaining to their ecology, environmental requirements, and distribution patterns arise. Many sources note the significance of temperature and humidity in the outcome of their distribution; however, no studies manipulating humidity have been conducted. The goal of this project is to assess the effect of moisture in the production and abundance of various species. Samples of leaf-litter collected from three temperate forest locations in southern Appalachia were dried, homogenized, randomly assigned to treatments of varying moisture content, and then monitored for the following eight weeks. A moisture gradient influencing the diversity and abundance of species is expected. The results obtained from this study can demonstrate how moisture affects the results

produced by moist chambers, provide insight into the abundance, diversity, and distribution patterns of myxomycetes inhabiting the leaf litter in the south Appalachian region, and have implications for explaining the biogeography of myxomycetes.

**5-08** Mammal use and occupancy modeling of bobcats *Lynx rufus* in a recently converted grassland in Tennessee. **Aurelia Christy**, *Austin Peay State University, Clarksville, Tennessee*. Soak Creek is a ~350 ha acre that was forested but recently converted into a grassland near Crossville Tennessee. We wanted to quantify animal use of this recently restored grassland to see how conservation actions lead to biodiversity gains. We placed 11 camera traps throughout the site with each camera being more than 200 meters away. To date, we have recorded 12 mammal species with what appears to be a significant number of individual bobcats. To further investigate bobcat use of the site we conducted occupancy modeling. Since detecting a species is often not accomplished with 100% accuracy, occupancy modeling can determine the true occupancy and detection probabilities of a species at a site. We hope that the modeling can give us a better understanding of the species using the newly converted grassland.

**5-09** New insights into pollinator communities associated with the federally endangered mustard *Physaria globosa*. **Christopher Waters\*** and **Shawn Krosnick**, *Tennessee Technological University, Cookeville, Tennessee*. *Physaria globosa* (Desv.) O’Kane & Al-Shehbaz (Brassicaceae) is a federally listed species found in 33 extant populations across Middle Tennessee, Central Kentucky, and Southern Indiana. Currently, little is known regarding the reproductive ecology of *P. globosa*. This study aims to document effective pollinator species for *P. globosa* across its range over multiple flowering seasons. Starting in 2021, floral visitors were collected from five populations representing each EPA level IV ecoregion where *P. globosa* is known to exist. Pollen was washed off of the collected insects; and visitors carrying *P. globosa* pollen were classified as potentially effective pollinators. Of all identified pollinators, 69% are hymenopterans, with all five common North American bee families represented. The pollinator communities for *P. globosa* are more diverse than previously thought and appear to be similar to other North American *Physaria* species. These data will be valuable in the ongoing conservation of *P. globosa*.

**5-10** Report on distribution and size abundance of the Saddleback crayfish *Faxonius durrelli* (Malacostraca: Decapoda: Cambaridae) located Giles County, Tennessee. **Hayden Galloway\***, **Chloe Cummins\***, **Shanna Hanes**, and **Stanton Belford**, *University of Tennessee Southern*. North American crayfish populations and species description are hampered by threats, such as habitat fragmentation, degrading water quality, and presence of invasive species within local aquatic habitats. Species identification using morphological and molecular analyses for members in family Cambaridae are necessary to accurately identify and monitor populations, especially in areas lacking in species information. We used morphological and molecular sequence data: two mitochondrial gene markers, cytochrome oxidase I subunit (COI) to identify crayfish species at sites in Giles County, Tennessee. Hand-held seines were used to collect crayfish. Morphological data recorded carapace length (CL-mm), total length (TL-mm), and weight (g). Results showed that crayfish TL differed significantly among sites ( $p < 0.05$ ). Molecular analyses recorded local species: *Faxonius durrelli*. This is the first molecular analysis and confirmed record for these species in this area. Annual surveys will continue to determine the status of the crayfish population densities and accurate species identification.

**5-11** Similar forested watersheds on the Cumberland Plateau reveal different patterns of biomass accumulation over a forty year period. **Maria I. Schutte\***, **Sarah McCarthy-Neumann**, and **Jonathan Evans**, *Tennessee State University, Nashville, Tennessee (MS, SM) and The University of the South, Sewanee, Tennessee (JE)*. Biomass accumulation may vary between sites of the same forest community type due to differences in nutrient availability and changes in species composition. This study examines changes in biomass accumulation and species composition at two sites in the Cumberland Plateau (Franklin State Forest and Fall Creek Falls State Park) over several decades. The two forests were of similar age, basal area and species composition. Using data collected in 1977 and 2015, we surveyed five 1-hectare plots in FSF and three 1-hectare plots in FCF, measuring all trees with a diameter of  $\geq 3$ cm and calculating their biomass. We found no significant difference in forest biomass in 1977 (FSF=146.3 Mg ha<sup>-1</sup>, FCF=157.0 Mg ha<sup>-1</sup>,  $p=0.29$ ), but there was a significant difference in 2016 (FSF=230.7 Mg ha<sup>-1</sup>, FCF=199.7 Mg ha<sup>-1</sup>,  $p=0.04$ ). The sites have also diverged in species composition (Sørensen’s Index, 1970s=67.9, 2010s=61.0), which is likely attributable to stochastic disturbance and recruitment regimes.

**5-12** Spatial analysis of 2022 Kentucky flood. **Holly Stripling\* and Breanna Roy\***, *Tennessee Technological University, Cookeville, Tennessee*. The topography of eastern Kentucky consists almost entirely of ridge and valley structures, and these structures are hypothesized to have contributed to unusually intense and catastrophic flood for the area during July of 2022. Fifteen Counties recorded to have issued flash flood warnings from 07/26/22 to 07/30/22. This study focuses on the flooding that occurred in these counties to show that ridge and valley structures might have directly impacted significant rise in the water table, leading to major floods. Understanding the topographic factor would allow for more preparation and possible preventative measures for flooding issues in the future. We use GIS to create a watershed delineation for the area. Other layers, like geology, land use, and soil types will be used to estimate peak flood volume. A summary of damages and areas affected by flooding in eastern Kentucky are included, such as the number of houses, businesses, and schools damaged.

**5-13** Temporal and vertical layering of animals in forested ecosystems in northwest Tennessee. **Taylor L. Underwood\* and H. Dawn Wilkins**, *The University of Tennessee at Martin, Martin, Tennessee*. Increases in vertical layering in ecosystems tends to correlate to higher diversity of animals due to increases in available niches. By placing feeders at different heights in the environment, our goal was to observe stratification of animals in forested ecosystems. We mounted motion sensing cameras 1 m and 3 m above the ground. Directly in front of the cameras we placed suet feeders. While birds were observed feeding at both heights, they were photographed most frequently on the 3 m feeders. Mammals were also observed feeding at both heights, but were photographed most frequently on the 1 m feeders. The overall diversity was slightly higher at 1 m than at 3 m. There was intermediate overlap in species composition between the two communities suggesting some vertical layering is occurring. We also observed temporal layering with mammals generally visiting the feeders at night and birds generally during the day.

**5-14** The importance of early successional habitat for conservation of herpetofaunal assemblages in Tennessee. **Carlin R. Frost, Jesse Eaker, and William B. Sutton**, *Tennessee State University, Nashville, Tennessee*. Increasing anthropogenic influence has exacerbated climate change and degraded ecosystems, leading to global biodiversity loss. Reptiles and amphibians (herpetofauna) serve as bioindicators of overall ecosystem health, pest and disease control, pollination, and seed dispersal. Status of snake populations is exceedingly difficult to determine due to cryptic and elusive behaviors, brief and patchy movement patterns, and use of inaccessible habitats. Across the Southern Appalachians, early successional habitats support unique flora and fauna but have declined over the last few decades due to farming, urban encroachment, and disturbance suppression. The Western Pygmy Rattlesnake (*Sistrurus miliarius streckeri*) is classified as Threatened within Tennessee and occupies floodplain habitat in the western part of the state. The primary objective of this research is to evaluate the spatial ecology and habitat use of Pygmy Rattlesnakes, determine the effects of management strategies on structuring herpetofaunal communities, and emphasize the importance of this habitat for Pygmy Rattlesnake conservation.

**5-15** The long-term effects of stream restoration on aquatic macroinvertebrates in a second-order stream in West Tennessee. **Sabin E. Bates\*, and Tom A Blanchard**, *University of Tennessee at Martin, Martin, Tennessee*. Stream channelization is the process of removing natural meanders of a stream to improve navigation and to increase drainage. Because of the known adverse effects of channelization, stream restructuring projects have been implemented by the West Tennessee River Basin Authority. In 2015, aquatic macroinvertebrates were collected to examine the initial response of these organisms to stream restoration. Our project examined longer-term effects of stream restoration on aquatic macroinvertebrates by sampling the same site after six years of habitat recovery. Both studies sampled organisms along three transects within the restored section, and along three transects in a channelized section. Both studies used kick-net sampling to collect organisms. All specimens were then preserved in 70% ethyl alcohol and returned to the laboratory at UTM for identification and enumeration. We determined density, taxa richness, taxa diversity, and community structure of aquatic macroinvertebrates and compared our results to information reported from the 2015 study.

**5-16** The use of testate amoebae as bioindicators of water quality within the Stones River Watershed: A case study from Murfreesboro, TN. **Jenna Voiles\*, Lauren Pearson\*, and Melissa Lobegeier**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Murfreesboro is one of the most rapidly

urbanizing cities in Tennessee as the population has increased by over 40% between 2010-2020. The city lies within the Stones River watershed and is subject to large amounts of urban and residential runoff. Ecosystem health, water quality, and invasive species are important environmental concerns within this watershed. We will focus on two primary issues within the watershed: the impact of the Middle Point landfill, which accepts 3,700 tons of solid waste daily from 34 surrounding counties, and the presence of invasive aquatic plant species within springs and wetlands. Our project uses testate amoebae, unicellular protozoans with a mineralized shell, as bioindicators of water quality and ecosystem health. Initial results indicate moderate water quality throughout the Stones River watershed except for the sample taken closest to the Middle Point landfill which contains only one testate amoeba indicating poor water quality.

**5-17** Towards the phylogenetic identification of zoantharians (Cnidaria: Hexacorallia: Zoantharia) found on reefs along the north-eastern coast of Toco, Trinidad. **Stanton G Belford and Chloe Cummins\***, *University of Tennessee Southern, Pulaski, Tennessee*. Caribbean coral reef communities continue to follow global trends of facing demise, or adaption due to current ecological crises. Annual biodiversity monitoring record data for benthic coverage of invertebrates on reef communities. One such invertebrate are zoantharians, which are benthic anemone-like organisms. In past studies, zoantharians surveyed on reefs at Toco, have only been visually identified as genus *Palythoa* and *Zoanthus* spp. We recorded morphological characteristics, such as oral disc and tentacle colors *in situ*. Mitochondrial 16S ribosomal DNA (16S rDNA) and the mitochondrial cytochrome oxidase subunit I (COI) genes were amplified, then sequenced. Oral disc colors were blue, green, brown, pink, and orange. Results identified three species-level zoantharians: *Z. pulchellus*, *Z. sociatus*, and for the first time *Z. aff. pulchellus*, which are comparable with Indo-Pacific species: *Z. vietnamensis*, *Z. sansibaricus*, and *Z. Kuroshio* respectively. All sequences were deposited online at NCBI, and GenBank accession numbers were assigned to specimens.

## Engineering & Engineering Technology Posters

**6-01** Novel multi-component chalcogenide glasses. **Dakota Price\***, **Anna Sheets\***, **Catherine Bousard**, **Bohdan Mahlovanyi**, and **Roman Holovchak**, *Austin Peay State University, Clarksville, Tennessee (DP, AS, RH)*, *Université de Rennes 1, France (CB, BM)*. The demand for novel multi-component chalcogenide glass grows with increased technological need for various optical and electronic devices such as phase-change memory, thermoelectric devices, infrared cameras, etc. In order to synthesize a multi-component glass with required properties, we combined elements of germanium, gallium, phosphorus, tellurium, antimony, and selenium together in the predetermined ratios. In this experiment we increased the amount phosphorus in order to find the maximum concentration we could use in the synthesis while sustaining the glass stability. These glasses were then verified using infrared cameras, to ensure the absence of any crystalline structure, and analyzed using DSC, optical spectroscopy, and XRD. APSU team acknowledges the financial support from the NSF IRES – 1 program (grant: OISE-2106457).

**6-02** Quantifying the *optical properties of opaque fluids* using inverse adding-doubling. **Amritpal Singh\***, **Ankit Patras**, and **Brahmaiah Pendyala**, *Tennessee State University, Nashville, Tennessee*. *Optical properties of an opaque fluid* play an important role in microbial kinetic studies. In this study, the optical properties (absorption coefficient,  $\mu_a$ ; reduced scattering coefficient,  $\mu'_s$ ) of almond milk (AM) were quantified using the inverse adding doubling (IAD) at 254 nm wavelength. IAD is an accurate solution of the radiative transport equation. Measurements were taken using a double-beam spectrophotometer and an integrating-sphere apparatus. The absorption and reduced scattering coefficients were mathematically calculated as  $6.46 \pm 0.2$  and  $7.71307 \pm 0.2$   $\text{cm}^{-1}$  respectively with the UV transmission of  $3.4\text{E}-05\%/ \text{cm}$ . The IAD obtained *optical properties* were compared with methods based on the Beer-Lambert law.  $\mu_a$  was calculated as  $16.73 \pm 0.01$   $\text{cm}^{-1}$ . The results show IAD obtained  $\mu_a$  was 2.6 times lower than methods based on conventional spectroscopy. In the future, these *optical properties* will be validated using a microbial surrogate *Escherichia coli* ATCC 25922 using a kinetics approach in buffer and AM.



**6-03** The Smart Cart—a prototype assistive device to promote independent shopping. **Joshua A. Eib\***, **Alyssa K. Young\***, **Kevin A. Cotter\***, **Mia Lopez\***, and **Md. Ali Haider**, *Austin Peay State University, Clarksville, Tennessee*. For some, it can be challenging to utilize a shopping cart for the entirety of a grocery trip. A motorized scooter is difficult to navigate, especially if the aisles are narrow and other shoppers are moving past. Moreover, there is no guarantee of a scooter being available for use at any given establishment. In an effort to increase accessibility and promote technology integration in the community, we developed a prototype of a Smart Cart. The Smart Cart is a self-propelled, motorized shopping cart that can follow a user into, throughout, and out of a store. The initial goal was to create a cart that follows a unique individual, can hold one hundred pounds of shopping goods, and has an operational life of four hours per charge. The target consumer for this product would be elderly or disabled individuals that need extra assistance while shopping for their consumable items.

**6-04** Through the eyes of a horse, experimental identification of blind spots and education via virtual reality. **Maggie Malone\***, **Anna Green\***, **Jason Roberts**, **Saman Sargolzaei**, *The University of Tennessee at Martin, Martin, Tennessee*. With rising interest in equine, there is a need to better understand and educate people on how to approach and interact with horses more appropriately. Literature reports that horses have blind spots in their visual field. Our study aimed at the experimental identification of blind spots. We drew a symmetrical circle and divided the angles of the circle on the ground. After locating the horse in the middle of the circle, we visited each angle while waving a prop and recording the horse's reaction. We used this data from the experiment to determine the exact blind spots of a horse's vision. We used a 360 camera to develop a virtual reality tour to better educate the concept of the blind spot. The data shows that the horse can see from zero to 170 degrees on each side, with blind spots identified as 170-190 degrees.

## Geology & Geography Posters

**7-01** Accumulation of algal toxins in the Tennessee State University wetland, Nashville, TN. **Aaliyah Cotton\***, **De'Etra Young**, and **Tom Byl**, *Tennessee State University, Nashville, Tennessee (AC, DY, TB), U.S. Geological Survey, Nashville, Tennessee (TB)*. Beavers expanded a series of wetland ponds on Tennessee State University's main campus in Nashville, Tennessee. This wetland system has experienced eutrophication and harmful algal blooms in recent years. In September of 2022, a serious drought dried a section of the wetland, leaving snail shells, algae and aquatic macrophytes (*Myriophyllum*) drying on the surface. Samples were collected and analyzed to determine if algal toxins were concentrated in the dried detritus. A 14-inch soil core was also collected and cut into 2-inch sections and analyzed for toxins. The dried algae and shells contained microcystin toxin concentrations above 5 micrograms per gram dry weight. The soil cores ranged from a high of 1 microgram per gram sediment in the top two inches to a low of 0.17 six inches below the surface. Ongoing research will determine if the toxins in the detritus and sediments can redissolve when water returns to the wetland.

**7-02** Bus routing and chronic absenteeism: GIS modeling to increase school attendance in a rural Tennessee county. **Sierra G. Alexander\*** and **Dr. Peter Li**, *Earth Sciences, Tennessee Technological University, Cookeville, Tennessee*. The purpose of this study was to develop more efficient pupil transportation routes for a rural, Tennessee school district with high rates of chronic absenteeism. In this district, only students who live outside a radius of 1.5 miles from a school were eligible for school bus transportation. The primary objective of this study was to identify areas of high student absenteeism to determine prime locations for new bus stops within the 1.5-mile radius of the school. The secondary objective was to redesign individual bus routes to incorporate the new bus stop locations while increasing the efficiency of each route. The study revealed concentrated areas of high chronic absenteeism within the 1.5-mile radius of the school. GIS functions and tools will be applied to the modeling processes; especially address geocoding and network analyst are used to create optimal bus routes to transport all, if possible, students to schools.

**7-03** Characterizing microplastic pollution in Mammoth Cave National Park. **Callie Hilgenhurst\*, Eli Kane\*, Rickard Toomey, Tom Byl, Monica Arienzo, and Jessica Oster**, *Vanderbilt University, Nashville, Tennessee (CH, JO), the Searle SyBBURE Undergraduate Research Program (CH), School for Science and Math at Vanderbilt (EK), Mammoth Cave National Park (RT), Tennessee State University, Nashville, Tennessee (TB), Desert Re.* Microplastics (MPs) are an emerging environmental concern because of the collective increase in plastic entering waterways. Little is known about MP transport into karst, though MPs have been found in groundwater and cave sediments. Given the potential risks, characterizing MPs in caves is essential. Here we present an initial count and characterization of MPs in Mammoth Cave National Park, KY. To find the source of MP pollution, we sampled water and sediment sources inside the cave with varying proximity to tour routes, and the Green River outside the cave, which occasionally flows into the cave during heavy rainfall. We found a predominance of fibers, pointing to tourists as a primary source of MPs into the cave environment. Green River samples yielded the most MPs/L (2.09), compared to counts from Echo and Styx (0.42 and 0.8 MP/L), suggesting that MPs enter this ecosystem without tourist input.

**7-04** Evaluating changes in wetland size and plant coverage from 1996 - 2021 using GIS and Google Earth. **Chelsea Randle\*, Reginald Archer, and Tom Byl**, *Tennessee State University, Nashville, Tennessee (CR, RA, TB), U.S. Geological Survey, Nashville, Tennessee (TB).* Wetland areas serve as a focal point for interactions between humans and nature and are valuable natural resources with the potential to provide local benefits. Plants, which are often the most numerous living things in a wetland, have an impact on the physical makeup of the aquatic environment. Wetlands are critical to the quality of our water resources as well as wildlife. A thirty-acre wetland is part of a large research farm managed by Tennessee State University. The present wetland started as a perennial small stream draining much of north Nashville until beavers built a series of dams beginning in 1996. Google Earth images were used to document wetland size doubling every 5 years. During the image analysis, eutrophication and changes in wetland emergent vegetation patterns were evident and will be evaluated.

**7-05** Graphical method of determining area and geographical center of Indian Ocean. **Arjun Tan**, *Alabama A & M University, Normal, Alabama.* Determining the area and geographical center of a nation or a state is of great interest to geographers, cartographers and the common public alike. However, no mention of the geographical centers of the oceans can be found in the literature. In this study, we devise a method to determine the area and geographical center of Indian Ocean as an example. This is done graphically using spherical polar coordinates. Two descriptions of the Indian Ocean are considered: one, the Greater Indian Ocean with its southern boundary extending up to Antarctica; and two, a Truncated Indian Ocean with the southern boundary at 60°S parallel of latitude. The areas in these two descriptions are estimated as 75,503,127 km<sup>2</sup> and 69,232,664 km<sup>2</sup>, respectively. The coordinates of the geographical centers in the two descriptions are determined to be (26.82°S, 77.37°E) and (25.51°S, 77.13°E), respectively.

**7-06** Graphical method of determining areas and geographical centers of Pacific Ocean and its northern and southern halves. **Arjun Tan**, *Alabama A & M University, Normal, Alabama.* In this following study, we determine the areas and geographical centers of the Pacific Ocean and its northern and southern halves using our previous graphical method. Two descriptions of the Pacific Ocean are considered: the Greater Pacific Ocean with its southern boundary extending up to Antarctica; and a Truncated Pacific Ocean with the southern boundary at 60°S parallel of latitude. The South Pacific Ocean is substantially larger than its northern counterpart in both versions. The Greater Pacific Ocean, including adjacent seas and Antarctic waters covers 35.54% of the entire globe. The center of North Pacific Ocean is located just north of the Tropic of Cancer; that of the Greater South Pacific Ocean is located well south of the Tropic of Capricorn; and that of the Greater Pacific Ocean is situated south of the equator. The calculated coordinates of the Greater Pacific Ocean matches with the center-of-mass coordinates of its northern and southern halves.

**7-07** Ground-level ozone before, during and after pandemic in Tennessee. **Ryan Stephens, Darby Francis, and Peter Li**, *Tennessee Technological University, Cookeville, Tennessee.* Ground-level ozone (GLO) exposure can trigger many negative health effects such as asthma, chest pain, and respiratory irritation among others. There are a substantial number of studies and data supporting the effects of GLO exposure and its negative effects on human respiratory systems. The study is conducted using data from

105 of the EPA air quality indexing stations located in the state of Tennessee and within 125 miles of the Tennessee state border. The data will be analyzed using three different interpolation methods: kriging, inverse distance weighted, and natural neighbor. The goal of this study is to observe the change in GLO over a time period of three years from January 2019 to December 2021. In this study we hypothesize to see a decline in GLO over the period of quarter 1 of 2020 to quarter 3 of 2021. Seasonal changes and regional variations will be presented, analyzed and summarized.

**7-08** Impact of zinc mining on water quality of North Hogan Creek, Gordonsville, TN. **Sydney Beltran\***, **Benjamin Lane\***, and **Peter Li**, *Tennessee Technological University, Cookeville, Tennessee*. Mining and its waste material are known to affect the surrounding environment through water and soil pollution. Studying the water quality of mines in rural areas like Gordonsville, Tennessee can give insight into the effects of zinc mining and its impact on local ecosystems. For this study, three sites were chosen along the North Hogan Creek, which drains into the Caney Fork River next to the Gordonsville Zinc Mine. Field parameters and a total of 20 samples were taken to document the relevant ions. The results from these tests showed sulfate, zinc, calcium, and magnesium were elevated at site three while nearby farmland likely contributed to nitrate and chloride in the water. Although these concentrations indicate an impact from the mine, these metals and anions do not actually exceed enforced EPA standards for freshwater. From this, we understand some effects of mining processes and land use on local water quality.

**7-09** Petrologic investigation of metamorphic rocks at Glade Gap, Chunky Gal Mountain in the western North Carolina Blue Ridge Mountains. **Kathryn Baumann\***, **Hannah Bates\***, and **Warner Cribb**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Chunky Gal Mountain, located in the N.C. Blue Ridge Mountains, is a tectonic mélangé largely consisting of greenschist, amphibolite, and granulite facies metamorphic rocks. This research identifies and describes variations in the petrologic compositions of rocks exposed at Glade Gap on Chunky Gal Mountain using data obtained by x-ray fluorescence, x-ray diffraction, and petrographic analysis. Prior studies show that likely Chunky Gal Mountain protoliths include pelitic to psammitic sedimentary and mafic to ultramafic igneous rocks. We have constructed a detailed description of rocks exposed at Glade Gap and correlated their geochemical and mineralogical variations to specific protolith compositions. Major element oxide concentrations of most Glade Gap samples are consistent with previous studies. Mafic/ultramafic protoliths are dominated by quartz + hornblende + plagioclase + actinolite + epidote. Pelitic protoliths are dominated by quartz + biotite + plagioclase + garnet. Psammitic protoliths are dominated by quartz + plagioclase + biotite + hornblende.

**7-10** Site selection for new recycling centers. **Jojo Brown\***, **Hannah Logue\***, and **Dr. Peter Li**, *Tennessee Tech University, Cookeville, Tennessee*. As recycling becomes more common among households, there becomes a greater demand for recycling centers in small communities. The more accessible recycling centers are in a community, the more inclined the community will be to recycle. This project aims to compare the locations of the existing recycling center in Cookeville, Tennessee with the population data in order to propose a potential location for a new recycling center. GIS layers, such as census demographic data, street layer, population counts, medium housing values, will be used to create distance models to show the current service area from existing recycling centers. Proposed future recycling centers will be determined based on demographic factors and future development plans.

## Health & Medical Sciences Posters

**8-01** Fiber evanescent wave spectroscopy application in Fabry's disease diagnosis. **Michael Truax\***, **Bohdan Mahlovanyi**, **Jozef Cebulski**, **Yaroslav Shpotyuk**, *Austin Peay State University, Clarksville, Tennessee (MT) and University of Rzeszów, Poland (BM, JC, YS)*. We investigated the use of infrared spectroscopy to detect Fabry's disease in dried urine samples using fiber evanescent wave spectroscopy (FEWS). FEWS allows non-invasive measurement of organic tissues and liquids. The concentration of globotriaosylsphingosine (lyso-Gb3) increases in the urine of patients with Fabry's disease. Chalcogenide glass (Ge<sub>21</sub>Te<sub>79</sub>)<sub>85</sub>(AgI)<sub>15</sub> optical fibers with exceptional sensitivity in the fingerprint region (spectral range from 600 to 1800 cm<sup>-1</sup>,) were used to analyze dried urine samples. Peaks were significantly

altered in the area from 1040 to 1180 cm<sup>-1</sup> show changes in proteins, lipids, and nucleic acids in the sample. We also found that drying the urine for 2 hours increased the signal strength 2 to 4 fold due to the removal of the obstruction of the spectra by water. This methodology has potential to be a quick, noninvasive technique for diagnosing disease.

## History of Science Posters

No poster presentations

## Mathematics & Computer Science Posters

No poster presentations

## Microbiology Posters

**9-01** Antimicrobial properties of roots, stems, and leaves of *Homalosorus pycnocarpos*, *Polystichum acrostichoides*, and *Sceptridium dissectum*. **Carolyn Johnson\***, **Avery Meyers\***, and **Darlene Panvini**, Belmont University, Nashville, Tennessee. Many plants used as traditional medicines have been found to have antiseptic and antibiotic properties. Ferns are among the plants used by Native American peoples for treatment of respiratory, dental, anti-inflammatory, and other illnesses. However, despite their wide use, research about antimicrobial properties of ferns is limited. To test for antibacterial properties, both dried and fresh material from the stems, leaves, and roots of *Homalosorus pycnocarpos* (glade fern), *Polystichum acrostichoides* (Christmas fern), and *Sceptridium dissectum* (Cut-leaf grape fern) were homogenized in ethanol. The disk diffusion method was used to test the antibiotic properties of the plant extracts on four ESKAPE pathogens. We expect to find antibiotic properties in these fern species, thus explaining their effectiveness in traditional medicinal use. This project aims to fill the gaps in research about antimicrobial properties of these fern species and identify which plant parts are potentially most effective in treating microbial infections.

**9-02** *Saccharomyces cerevisiae* growth changes in response to dietary supplements. **Abigail A. Beckett\***, **Laura H. Bechard**, Cumberland University, Lebanon, Tennessee. Vitamin supplements and essential oils have gained popularity in recent years, with claims that they can improve overall human health. Claims suggest that immune supplementation can be achieved by ingesting these compounds. Our research aims to test the validity of these claims using the yeast *Saccharomyces cerevisiae* as a model system. *S. cerevisiae* was chosen due to its homolog of human NOD like receptors that distinguish self from non-self. First, we grew *S. cerevisiae* in the presence of several oils and supplements to test whether these substances had an overall effect on the growth rate of the yeast. Supplements such as vitamin D3, B6, and C supported yeast growth, while oil extracts from several plants were detrimental to yeast growth. Supplements having positive or no effects on yeast growth will be subjected to further testing, which will include a viral challenge on yeast growing in the presence of these supplements.

**9-03** Comparison of kanamycin-resistant bacteria in earthworm digestive tracts and soil from compost bins. **Samantha Dooyema\***, **Abigail Morse\***, **Chris Barton**, **Darlene Panvini**, Belmont University, Nashville, Tennessee. Antibiotic-resistant bacteria are becoming more prevalent in soil as humans have increased impacts on the environment. Previous research proposed that earthworms could affect bacteria distribution as soil is ingested and filtered through their bodies. This research aims to see if kanamycin-resistance bacteria is the same in earthworm digestive tracts as in the soil the earthworms inhabit. We

expect that the gut contents and soil will vary in the occurrence of kanamycin-resistant bacteria. Earthworms and composted soil samples were collected from compost bins at a residential home in Nashville, Tennessee. Digestive tracts were dissected from the earthworms and homogenized. Kanamycin-resistant bacteria were isolated from the gut contents and soil samples, then identified to genus using DNA barcoding and Sanger sequencing of 16S rDNA. Comparison of the kanamycin-resistant bacteria in the composted soil and earthworms may give insight into the role that earthworms play in the movement of soil antibiotic-resistant bacteria.

**9-04** Effect of electronic cigarette generated aerosol on the mortality and size of *Caenorhabditis elegans*. **Sarah Hopkins\***, **Amanda Bresnahan**, **Sarah-Camille Garcia**, **Georgiana Griffin**, **Julie Hall** and **Dominic Palazzolo**, *Lincoln Memorial University, Harrogate, Tennessee*. Research suggests that electronic cigarette (ECIG) generated aerosols have a detrimental effect on a variety of immortalized cell lines. However, there is a paucity of information regarding the effects of ECIG-generated aerosols on intact organisms. For this reason, three groups of *Caenorhabditis elegans* (*C. elegans*) were exposed to 60 daily puffs of ECIG-generated aerosol (sham control, flavorless and cinnamon flavored aerosols). Mortality of *C. elegans* was monitored daily for twelve days from the start of adulthood. Similarly, size of *C. elegans* was monitored during this same time frame. The results indicate that 60 daily puffs of flavorless and cinnamon flavored ECIG-generated aerosols do not significantly alter the mortality and the size of *C. elegans* as compared to the sham control. It is possible that increasing the number of daily puffs or altering the flavor of the aerosol could produce significant effects on the mortality and size of *C. elegans*.

**9-05** Investigation of co-infection between *Trichomonas gallinae* and *Salmonella* in hunter-killed mourning doves (*Zenaidura macroura*). **Madison G. Brassfield\***, **Morgan D. Simpson**, and **Kathryn E. Purple**, *Lincoln Memorial University, Harrogate, Tennessee*. *Trichomonas gallinae*, a protozoan parasite, is often found in healthy pigeons and doves; however, it can cause disease in any bird species. Secondary infections with *Salmonella* and *Trichomonas* have been found, but there is no scientific literature on this association. Our aim is to determine if there is a relationship between *Salmonella* and *Trichomonas* infections in hunter-harvested mourning doves from the Forks of the River Wildlife Management Area. The oral cavities of 50 and 48 mourning doves from 2021 and 2022, respectively, were swabbed and introduced into *Trichomonas* media and incubated at 37°C for 5 days and monitored for protozoa. One positive *Trichomonas* sample was found in culture 2021 and two were found in 2022. All cultures were frozen for DNA extraction and PCR for the presence of *Salmonella* and *Trichomonas* DNA. These results will provide a framework to understand the pathogenicity of these infections in wild birds.

**9-06** Occurrence of kanamycin-resistant bacteria relative to human activity along Richland Creek in Nashville, Tennessee. **Jolene Mach\***, **Brandon Ramirez\***, **Chris Barton**, and **Darlene Panvini**, *Belmont University, Nashville, Tennessee*. The overuse of antibiotics has caused an increase in antibiotic resistant (AR) bacteria, which is a serious public health concern. Previous studies showed a significant correlation between anthropogenic pollution and AR bacteria. This project aims to identify AR bacteria in Richland Creek relative to local anthropogenic pollution. Water samples were collected at four locations along Richland Creek in Nashville, Tennessee. Bacteria resistant to the antibiotic kanamycin were isolated from the water samples, identified to genera using DNA barcoding, and compared among the sites. We expect to see greater abundance and diversity of kanamycin-resistant bacteria closer to the end than near the head of the creek. This research project can help describe the diversity of AR bacteria species present in the stream in different areas of Nashville and has public health consequences if the disparities in the distribution of AR bacteria correlates to human activity and/or socioeconomic differences along the stream.

**9-07** Optimized In vitro zoospore production of *Phytophthora helicoides*, a water borne plant pathogen. **Bhawana Ghimire\*** and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. *Phytophthora helicoides* is an emerging root-rot disease causing phytopathogen with a wide host range. Zoospores, the asexual spores are main infections propagules of this pathogen. There is no reported reliable zoospore production protocol available for this pathogen to conduct scientific studies. In this study, abundant zoospore production protocol was optimized in the laboratory condition. Different temperature, time, and light-dark conditions to grow, starve the mycelium, and shock to release

zoospores were tested. *P. helicoides* was grown in liquid media for 72 hrs, media was drained, and replaced by sporulation medium. The cultures were then incubated under fluorescent light (400-700nm;  $300 \text{ mol m}^{-2} \text{ s}^{-1}$ ). The plates were then subjected to cold temperature shock. Using this protocol, a zoospore suspension of at least  $2 \times 10^5$  /mL could be quickly obtained irrespective of the season using an incubator, V8 broth media and pond water. This protocol could be utilized in various *P. helicoides* related studies.

**9-08** Prevalence of *Clostridiodes difficile* among wild birds at Harrogate, Tennessee. **Sarah Long\* and Muthu Dharmasena**, *Lincoln Memorial University, Harrogate, Tennessee*. *Clostridiodes difficile* is an endospore-forming, anaerobic pathogenic bacteria that infects the human intestines that cause symptoms such as swollen abdomen, nausea, diarrhea, blood or pus in the stool, and fever. The bacterium is carried by shed by livestock animals including chicken and domesticated animals. Shedding the bacterium with endospores may spread and contaminate the environmental sites such water and soil. The purpose of this study is to isolate *C. difficile* in feces of wild birds associated with parks in Harrogate, TN. Fecal samples (n=50) will be collected and enrichment culture method will be used to isolate the target bacterium under anaerobic incubation. Presumptive colonies will be confirmed as *C. difficile* by PRO disc method, PCR for *tpi*, and latex agglutination tests. Isolates will be tested for toxigenic genes, *tcdA*, *tcdB*, *cdtA*, and *cdtB*, and antimicrobial resistance. Our study will provide a valuable impact on the environmental reservoir *C. difficile*.

**9-09** Relationship between kanamycin-resistant bacteria on playground equipment and local socioeconomic status. **Remah Hatem\*, Shaimah Abu-Bakr\*, Donia Mousley\*, Chris Barton, and Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Antibiotic resistance is a universal public health issue associated with infections that are harder to treat, prolonged hospital stays, higher medical costs, and increased mortality. Previous studies suggest that antibiotic resistance in some locations is linked to the socioeconomic status of the area. In this study, three Nashville metro playgrounds from areas with lower socioeconomic status were compared to three playgrounds from more affluent areas. Playground equipment at each site was swabbed and the bacteria cultured to isolate kanamycin-resistant bacteria. PCR amplification of the 16s rDNA sequence was used for DNA barcoding to identify the bacteria. The expected results are that kanamycin-resistant bacteria will be more prevalent in less socioeconomically inclined areas than in more affluent areas, which is consistent with previous studies. People living in areas of lower socioeconomic status may experience greater negative health effects due to poor sanitation, limited healthcare access, and/or higher rates of antibiotic misuse.

**9-10** Translational frameshift in the tail assembly chaperone in the novel bacteriophage SeaWolves. **James Bautista\*, Annaleisa Matzirakis\*, Miriam Galindo, Julie Mattson, Jaeden Kennedy, Jesse Lampley, Wilson Myers**. *Columbia State Community College, Tennessee*. The goal of this study was to characterize and annotate the novel bacteriophage SeaWolves from the EE cluster. Previously, we had discovered and annotated 2 other novel Actinobacteriophages of the EE cluster, Vanisius and Jannah. These bacteriophages utilize the lytic cycle and their genomes are relatively small in size. Comparative genomic analysis demonstrated that these phages have a programmed translational frameshift in the tail assembly chaperone gene. We identified the conserved slippery nucleotide sequence within the tail assembly chaperone gene by searching for slippery sequences across the 88 phage members of the EE cluster. Genome analysis and annotation were performed using the PECAAN annotation software tool. We conclude that the conservation of the slippery motif in the EE phages was an evolutionary advantage leading to successful phage infection.

## Physics & Astronomy Posters

**10-01** Equichalcogenide glasses for phase change memory and sensor applications. **Yuriy Holovchak\*, Roman Golovchak, and Andriy Kovalskiy**, *Austin Peay State University, Clarksville, Tennessee*. Amorphous chalcogenide materials are prospective for application toward sensors, phase change

memory devices and telecommunication. Recently, a new family of Ge-Sb-S-Se-Te equichalcogenides was shown to be a universal matrix combining all required properties. In this work, temperature dependence of resistivity and the optical transmission spectrum are studied for Ge-Sb-S-Se-Te thin films. The calculated optical gap shows linear temperature dependence, while changes in dark resistivity are found to follow exponential decay. A steep decline in DC resistivity is observed at around 145 degrees Celsius in thin films of Sb-rich compositions. The attained low-resistivity state (~5 orders of magnitude smaller than the initial resistivity) is stable when cooling the material back down. Chalcogen-rich films demonstrate a strong photocurrent response under exposure from 400-1000 nm wavelengths and this effect decreases with temperature.

**10-02** Numerical exploration of *Morpho*-inspired nanostructures for tunable structural color. **Meleah Lanier\*** and **Eugenii U. Donev**, *Austin Peay State University, Clarksville, Tennessee*. Structural color arises when light reflects from a nanostructure via interference and diffraction as opposed to pigmentation. Structural colors are some of the most brilliant colors in nature: the blue of the *Morpho* butterfly is one of the most notable examples. This project involves computer simulations of the nanostructures using the finite-difference time-domain (FDTD) method and modifying the geometry to observe the effects on the spectra and angular distribution of the reflected light. We present our progress towards understanding structural color and exploring the parameter space of *Morpho*-inspired nanostructures with a view to simulating structural color that is tunable across the visible spectrum.

**10-03** RR Lyrae Variable Star RV Mensa. **Eden Kope\***, **J. Allyn Smith**, *Austin Peay State University, Clarksville, Tennessee*. Observations of the under-researched RR Lyrae variable star RV Mensa were obtained at the Cerro Tololo Inter-American Observatory in September 2019. The instrumental magnitudes of RV Men over these nights varied between 1.13 and 2.15 in the SDSS-g filter. The variable was compared to 4 comparison stars to guard against their variability. The reported pulsation period is 13.0510 hours per the American Association of Variable Star Observers (AAVSO). Though we find there were not enough observations to fully confirm this period we present our four filter data and discuss the trend in the potential period.

**10-04** The Stellar Population of the Open Cluster Dolidze-35 Field. **Meagan Porter\***, **J Allyn Smith**, *Austin Peay State University*. Dolidze-35 is an under-observed open cluster in the northern hemisphere. We are actively working to characterize this cluster and have imaging data covering four years. These data are a combination of imaging, spectroscopy and GAIA astrometry. We present early SDSS-ugriz photometric results of 1600 stars in the half degree field surrounding the cluster. The ugriz-data are combined with existing JHK data from 2MASS. We find the cluster is at a distance of approximately 1.3 kpc and is relatively young; less than 1 Gyr based on turnoff spectral type. We point out the variable stars identified in the field and compare these to known variables.

**10-05** The variable star BK And. **Li N. Loy\***, **J. Allyn Smith**, *Austin Peay State University, Clarksville, Tennessee*. Data taken from a three-night observation of BK And in 2019 was analyzed to determine the magnitudes of the variable star. The magnitudes from those nights were in the range of 14.1697 – 15.029 V with a period of 10.4 hours. This data varies enough from previously recorded values to justify further research to prove the star's status as a Blazhko star.

## Science and Math Teaching Posters

**11-01** Remote online open-book open-web versus face-to-face online closed-book closed-web examinations in anatomy and physiology classes. **Lauren Milam\*** and **Donald Shaw**, *University of Tennessee at Martin, Department of Biological Sciences, Martin, Tennessee*. Due to COVID and distance learning, a possible evaluation is open-book examinations. We tested the hypothesis that students taking open-book, open-web exams spend less time studying anatomy and physiology compared to students taking closed-book, closed-web exams. Moreover, we tested the exam performance using different types of exam questions according to Bloom's taxonomy. Data from the open-book section had shown that

students' exam performance over five different types of questions were descending as the level of difficulty became more challenging in both Exams #1 and #2. These results suggest that students in the open-book open-web group deal with challenging questions poorly. The data for Exam #3 and final of the open-book group has been collected and analyzed. Moreover, the data for Exams #1 through #3 of the closed-book group has been collected, analyzed, and included for comparison.

## Zoology Posters

**12-01** Does the presence of larval Marbled Salamanders (*Ambystoma opacum*) affect the growth of larval Mole Salamanders (*Ambystoma talpoideum*)? **Buffy Lehman\***, and **Tom Blanchard**, *University of Tennessee at Martin, Martin, Tennessee*. A previous study conducted in Weakley County Tennessee, showed that larval growth rates of Mole Salamanders (*Ambystoma talpoideum*) increased after emergence of metamorph Marbled Salamanders (*Ambystoma opacum*) from ephemeral pools. We hypothesize that larval Marbled Salamanders limit feeding opportunities of larval Mole Salamanders thus slowing growth. The two objectives of the current study are to establish that larval Marbled Salamanders are predators of larval Mole Salamanders and to determine if larval Marbled Salamanders influence the feeding behavior of larval Mole Salamanders. To date, we have determined that smaller size classes (14 mm – 28 mm SVL) of larval Marbled Salamanders feed on copepods, ostracods, cladocerans, and amphipods. We will examine stomach contents of larger size classes of larval Marbled Salamanders later this year. In the spring of next year, we will conduct behavioral trials to determine the effects of Marbled Salamanders on the feeding behavior of Mole Salamanders.

**12-02** Mortality of Eastern Bluebirds roosting in nest boxes during a severe winter storm in southwest Kentucky and northwest Tennessee. **Sevyn Brothers\*** and **H. Dawn Wilkins**, *University of Tennessee at Chattanooga, Chattanooga, Tennessee, and University of Tennessee at Martin, Martin, Tennessee*. Eastern Bluebirds (*Sialia sialis*) roost together in nest boxes during the winter, possibly to conserve heat. During severe winter storms, food resources become scarce and bluebirds have been found dead in boxes. Ninety bluebirds were recovered from nest boxes in southwest Kentucky and northwest Tennessee following a severe winter storm. The storm was followed by nine days of below freezing temperatures. Our goal was to determine the sex, age, weight, and overall physical condition of each bird. More males were found dead than females. We aged birds as either second-year (SY) or after-second-year (ASY) individuals. There were more ASY individuals than SY in the boxes. The average weight of males and females was similar and they weighed less than expected compared to living bluebirds. The majority of specimens were in fair to poor condition. Breeding success in the year following the storm was approximately 70% lower than previous years.

**12-03** Occurrence of bat species at water sources in two urban parks in Nashville, Tennessee. **Maya Kiev\***, **Austin Farris\***, **Evan Mason\***, and **Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Animal behavioral patterns can shift due to anthropogenic factors related to pollution, human impact on flora/fauna, and changes in local water sources. While sound pollution can impact the occurrence of bats in urban areas, other factors could also influence bat behavior. This study examines bat occurrence near a water source at two urban parks in Nashville, Tennessee: one is in a highly trafficked area while the other is secluded and bordered by a suburban neighborhood. Both parks have small ponds, numerous trees, and open green spaces. Echo Meter Touch 2 devices were used to capture bat echolocation data at each park near the ponds and in open areas. Kaleidoscope was used to identify the bat species. We expect more calls near water sources and a greater diversity of bats in the secluded park. These results can provide information regarding impacts of anthropogenic factors on bat occurrence in urban areas.

**12-04** Occurrence of exotic and native earthworms in residential compost bins. **Shannon Jeffries\***, **Rachel LaFont\***, **Chris Barton**, and **Darlene Panvini**, *Belmont University, Nashville, Tennessee*. While earthworms are an essential aspect of indigenous terrestrial ecosystems, they can also play a key role in compost bins. Earthworms and their eggs can enter open compost bins directly or indirectly through organic matter added to bins. This research examines the diversity of earthworm species in residential



compost bins, specifically noting the distribution of exotic and native species of Oligochaeta. Earthworms were extracted from compost bins in different locations in Nashville, Tennessee. After extraction, the worms were placed in ethanol and DNA barcoding was used to identify the species of earthworms present in the bins. The hypothesis is that compost bins will contain more exotic than native species of earthworms and that the occurrence of worms will be related to compost temperature and moisture. The introduction of exotic species into native habitats creates competition with native species and changes biotic processes, including those in compost bins.

**12-05** Survey of haemosporidian parasites from Lesser Prairie Chickens (*Tympanuchus pallidicinctus*) from Kansas and Texas. **E. Morgan Tolliver\***, **Nubia Salinas\***, **Nicolas Triana**, **Kristen J. Bondo**, **Blake A. Grisham**, **Dan S. Sullins**, and **Whitney M. Kistler**, *Lincoln Memorial University, Harrogate, TN (EMT, NS, NT, WMK)*, *Texas Tech University, Lubbock, TX (KJB and BAG)*, and *Kansas State University (DSS)*. The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a grassland grouse species with a declining population. The main driver of the population decline is loss of sand sagebrush and shinnery oak rangeland habitat across their historic range. This has led the United States Fish and Wildlife Service to propose protection under the Endangered Species Act (ESA). Their declining population makes this species especially vulnerable to infectious diseases. Therefore, we screened blood samples collected from 2008-2010 in Texas (n=110) and in 2019 from Kansas (n=17) using a nested polymerase chain reaction to detect infection of haemosporidian parasites. Then, we bi-directionally sequenced positive samples. We amplified and sequenced a 995 base pair region of the cytochrome b gene from six (5.4%) of the samples from Texas and two (11.8%) of the samples from Kansas. We detected infected lesser prairie-chickens every year. These sequences matched 100% with *Plasmodium homopolare* from a California Condor (*Gymnogyps californianus*). This is the first report of *P. homopolare* in lesser prairie-chickens from Texas and Kansas. A previous study identified *P. pedioecetii* infections in lesser prairie-chickens from New Mexico; however, that study only used morphology for species identification. *Plasmodium homopolare* is a recently described species that has broad host and geographic ranges in the western hemisphere. Although no reports of pathogenicity have been documented with *P. homopolare* infections, haemosporidian parasites are known to have negative effects on wild bird populations. Additionally, this parasite has been documented in two species protected under the ESA, highlighting the need for further research into the effects this parasite can have on these populations.

**12-06** Utilizing acoustic recorders and light pan traps to calculate the relationship between bat feeding habits and insect biomass. **Summer Hatmaker\***, and **Dr. LaRoy Brandt**, *Lincoln Memorial University, Harrogate Tennessee*. In Tennessee, bats are essential. The purpose of this study is to determine if there is a correlation between bat activity and insect biomass. Acoustic echolocation recorders are used to track local bat activity and light pan traps are used to collect and kill insects. By collecting insects, we can determine food source availability. Compiling data on the total bat echolocation calls on a given night will show us how active the bats are at that point in time. Once we compare food availability and bat activity in a night, we hope to see trends where if there is bat activity there is more insect biomass. Bats play a crucial predator role in the environment. By equating insect biomass to bats' feeding habits, we will be able to determine where the bats are frequenting. This will also give us insight into food foraging and other activities outside of the caves.

## TAS Standing Committees 2022

### **Auditing and Financial Oversight Committee**

**Dr. Tommy Wooten, Chair, Belmont University**

Dr. Steven Murphree, ex-officio advisor, Belmont University

### **Education and Research Committee**

**Dr. Theresa Barke -- Clarksville Montgomery County School System Teacher, Austin Peay State University Adjunct**

Dr. Linda Jordan – Science Consultant

Dr. Angela Malone – Columbia State

Dr. Jennifer Mandel – University of Memphis

Dr. Alicja Lanfear- Middle Tennessee State University

### **Fellows Committee**

**Dr. Charles R. McGhee, Chair, Middle Tennessee State University**

Dr. Gladius Lewis, University of Memphis

### **Long Range Strategic Planning Committee**

**Dr. Amy Thompson, Chair, Austin Peay State University**

Dr. Darlene Panvini, Belmont University

Dr. Allyn Smith, Chair, Austin Peay State University

Dr. Fred Matthews, Austin Peay State University

Dr. Gilbert Pitts, Austin Peay State University

Dr. Kim Cleary Sadler, Middle Tennessee State University

Ms. Mandy Carter-Lowe, Columbia State Community College

Ms. Teresa Fulcher, Pellissippi State Community College

Dr. Karen Kendall-Fite, Columbia State Community College

Dr. Steven Murphree, Belmont University

Dr. Daniel Swartling, Tennessee Tech University

### **Membership Committee**

**Dr. Karen Kendall-Fite, Chair, Columbia State Community College**

Dr. Gary Hall, David Lipscomb University

Dr. Jeffrey Lebkeucher, Austin Peay State University

### **Necrology Committee**

**Dr. Roger Jackson, Chair, Cumberland University**

### **Nominating Committee**

**Dr. Amy Thompson, Chair, Austin Peay State University**

Dr. Darlene Panvini, Belmont University

Dr. Allyn Smith, Chair, Austin Peay State University

Dr. Fred Matthews, Austin Peay State University

Dr. Gilbert Pitts, Austin Peay State University

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