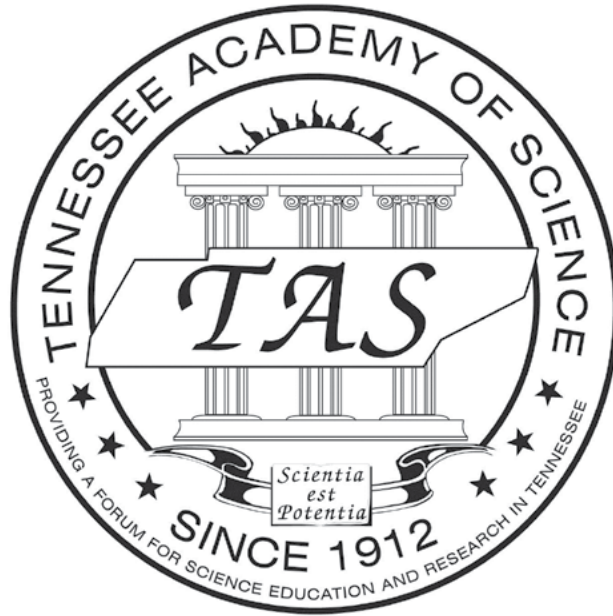


**133<sup>rd</sup> Meeting  
of the  
Tennessee Academy of Science**



**November 18, 2023**

**This meeting is hosted by Rhodes College**

**Celebrating 111 Years**

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

Austin Peay State University  
Middle Tennessee State University  
Motlow State Community College  
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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***

2024 – Lincoln Memorial University  
2025 – Pellissippi State Community College  
2026 – TBA

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## **Welcome . . .**

... to the 2023 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 Rhodes College for hosting our meeting!

... to Dr. Gregory Vieira for serving as the Chair of the Local Arrangements Committee! We appreciate all that you have done to host this meeting.

... to the Rhodes College Office of Academic Affairs as well as to the Departments of Biology, Chemistry, Computer Science, Physics, and Mathematics, as well as the Biochemistry and Molecular Biology, Environmental Studies and Sciences, and Neuroscience Programs for support toward the 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 2024 at your Division  
Meeting**

**Tennessee Academy of Science Collegiate Meetings  
Spring 2024**

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

**East Tennessee Collegiate Division Meeting**

TBA; Information will be emailed as it is finalized.

**Middle Tennessee Collegiate Division Meeting**

Saturday, April 13, 2024

Cumberland University

Lebanon, TN

**Western Tennessee Collegiate Division Meeting**

Date: TBA

Christian Brothers University

Memphis, TN

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

## Tennessee Academy of Science Meeting at Rhodes College in Memphis, TN

### Meeting Schedule

All time listed are in CENTRAL STANDARD TIME

Note: BCLC = Bryan Campus Life Center

Friday, November 17, 2023

4:00 pm – 6:00 pm	Meeting Preparation for Executive Committee: Matthews Conference Room, 2 <sup>nd</sup> Floor of Briggs Hall
6:00 pm – 7:00 pm	Executive Committee Dinner: McWhorter Dining Hall in the Catherine Burrow Refectory
7:00 pm – 8:30 pm	Executive Committee Meeting: Matthews Conference Room, 2 <sup>nd</sup> Floor of Briggs Hall

Saturday, November 18, 2023

7:30 am – 1:30 pm	Registration in BCLC Lobby. Light breakfast served until 9am up the stairs in Crain Reception Hall
8:15 am – 8:30 am	Poster Session Sign In, BCLC Lobby
8:30 am – 9:45 am	Poster Session in BCLC Multi Sport Forum
10:00 am – 10:30 am	TAS Annual Business Meeting, McCallum Ballroom in BCLC
10:30 am – 11:30 am	Keynote speaker: Dr. Richard Kriwacki from St. Jude Children's Research Hospital and the University of Tennessee Health Science Center Title: Roles of Biomolecular Phase Separation in Biology and Disease McCallum Ballroom in BCLC
11:30 am – 1:00 pm	Lunch Break – Hyde Hall in the Catherine Burrow Refectory, with overflow in the Refectory as needed.
1:00 pm – 3:30 pm	Section Business Meetings and Oral Presentations (assigned rooms around campus)
2:30 – 3:30 pm	Networking Time with Snacks and Coffee, McCallum Ballroom in BCLC
3:30 pm – 3:40 pm	Judges Meeting Harden Conference Room inside Athletics Office, 2 <sup>nd</sup> Floor of the BCLC
3:40 pm – 4:30 pm	Student Awards Ceremony, McCallum Ballroom in BCLC

## Meet our Keynote Speaker

### Dr. Richard Kriwacki

Department of Structural Biology,  
St. Jude Children's Research Hospital,  
262 Danny Thomas Place,  
Memphis, Tennessee

Dr. Roger Kriwacki received a bachelor's degree in chemistry and a master's degree in pharmaceutical sciences and medicinal chemistry both from the University of Connecticut. He received a Ph.D. in biophysics from Yale University. He has been at St. Jude since 1997 and the University of Tennessee Health Science Center since 1998. The Kriwacki laboratory seeks to understand the molecular basis of regulation of essential biological processes (*e.g.*, cell division, apoptosis, ribosome biogenesis, and transcription) with emphasis on the roles of intrinsically disordered proteins (IDPs) and phase separation in these processes. We apply structural biology and biophysical techniques (NMR spectroscopy, x-ray crystallography, calorimetry, AUC, etc.), as well as biochemical, cell biological and cell imaging methods, to study the details of biomolecular mechanisms from the test tube to cells.

#### **Title: Intrinsically disordered proteins in biology and disease**

#### **Abstract**

While it is widely appreciated that many proteins adopt folded three-dimensional structures that mediate diverse biological functions—the so-called protein structure-function paradigm—some proteins lack folded features and are intrinsically disordered. Intrinsically disordered proteins (IDPs), and intrinsically disordered (protein) regions (IDRs), lack highly populated secondary structure and, in isolation, dynamically fluctuate between many different conformations. Importantly, IDPs and IDRs perform myriad biological functions, including roles as entropic bristles, scavengers, linkers, regulators, scaffolds, binders, amongst many others. Some IDPs and IDRs fold upon binding to their functional biomolecular partners, while others remain partially or even entirely disordered when interacting with their partners—forming so-called fuzzy complexes. Yet others were recently discovered to experience dynamic, multivalent interactions with themselves and other biomolecules that drive phase separation to form micrometer-scale, liquid-like assemblies referred to as biomolecular condensates. Biomolecular condensates are now understood to organize subsets of proteins, nucleic acids and other biopolymers within subcellular compartments to perform specific biological functions, dramatically changing our understanding of how diverse functions are organized in cells. I will present the full arch of discovery regarding the roles of IDPs and IDRs in biology, spanning their diverse mechanisms and functions, and will also highlight their causative roles in human diseases, including neurodegeneration and cancer.

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

**Oral Presentations**  
**Agriculture-Plant Sciences**  
**Chair: Dr. Diana Lynn Watson**  
**1:00 pm – 2:50 pm**  
**Ohlendorf 225**

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

**1:05-1:20** Genome-wide association study for root nodulation in field soybean. **Niraj Ghimire\***, **Korsi Dumenyo**, and **Ali Taheri**, *Tennessee State University, Nashville, Tennessee*. Nitrogen is a crucial nutrient for soybean growth and production. Nodules that fix nitrogen and look pink or red help soybeans grow better by reducing the need for extra nitrogenous fertilizers. Climate changes have altered soil conditions, limiting root growth and making it harder for plants to get water and nutrients, affecting plant growth and nodulation traits. Our research assesses nodulation related traits across 500 late maturing soybean accessions. We germinated seeds on germination paper and transferred them to blue blotting papers and captured root images after 21 days. Nodulation traits such as Nodules number and area will be evaluated using the Soybean Nodule Acquisition Pipeline (SNAP). R's tools measure population structure, kinship, and principal components. We'll use phenotypic and SNP data for Genome-wide Association Studies with the GAPIT package. This study targets genetic regions linked to nodulation traits, potentially unveiling valuable QTLs or genes for nodulation related traits.

**1:20-1:35** Enhancing the boxwood blight control using fungicides, antitranspirant, and host plant defense inducer. **Bhawana Ghimire\***, **Madhav Parajuli**, **Terri Simmons**, **Prabha Liyanapathirana**, and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Boxwood blight, caused by *Calonectria pseudonaviculata*, significantly threatens boxwood production. We assessed the efficacy of combinations of fungicides, plant defense inducer, and antitranspirant in controlling boxwood blight. Boxwood 'Green velvet' plants were subjected to different preventive and curative treatments at two-week intervals. Boxwood blight disease severity, disease progress, and moisture potential were assessed. Results revealed that curative application of a low rate of Postiva, preventive plus curative applications of Postiva alternated with Vapor Gard, Daconil Weatherstik alternated with KleenGrow, and KleenGrow significantly reduced disease severity compared to the non-treated control. The lowest disease progress occurred with treatment of Postiva alternated with Vapor Gard and the plants with the same treatment had the lowest moisture potential. Particularly, a positive correlation existed between disease development and moisture potential. Rotation of fungicides and antitranspirant, combined with other strategies such as usage of tolerant cultivars, sanitation practices can be employed to manage boxwood blight.

**1:35-1:50** Assessing *Hydrangea* cultivars and hybrids for their powdery mildew tolerance and susceptibility. **Christina Jennings\***, **Lisa Alexander**, and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. *Hydrangea* is a popular ornamental shrub worldwide. Diseases negatively impact the beauty and marketability of hydrangea plants. Powdery mildew on hydrangea is caused by the obligate biotrophic fungus *Golovinomyces orontii*. The purpose of this study was to compare the tolerance of various hydrangea species, cultivars, and hybrids to powdery mildew. Cultivars and hybrids of bigleaf hydrangea and Chinese quinine (*Hydrangea febrifuga*) were assessed weekly within their respective trial periods for disease severity on a scale of 0-100% foliage area affected. The whole plant trials were carried out in 2018, 2019, and 2020 with an additional rooted cutting trial in 2020. In each year, there were significant differences among genotypes for powdery mildew disease severity. Results showed that bigleaf hydrangea cultivars have varying levels of susceptibility while Chinese quinine is tolerant to powdery mildew infection, and that hybrids between the two species are also powdery mildew tolerant.



**1:50-2:05** Identification and pathogenicity of fungal species causing canker diseases on redbud in Tennessee. **Pratima Subedi\***, **Farhat A. Avin**, **Prabha Liyanapathirana** and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Redbud (*Cercis* spp.) is one of the most popular deciduous flowering trees and Tennessee is the number one redbud-producing state in the U.S. Large-scale production of redbud has been greatly challenged by its susceptibility to canker diseases. The objective of this study was to identify the pathogens associated with the canker diseases affecting redbud production in Tennessee. Symptomatic redbud plant samples received from commercial nurseries were processed and fungal isolates were identified using morphological characteristics, phylogenetic classification by multiple genes, and qPCR assays in 2022 and 2023. *Botryosphaeria* sp., *Didymella* sp., *Diaporthe* sp., *Fusarium* sp., and *Neopestalotiopsis* sp. were most frequently identified in the symptomatic plants. Pathogenicity tests performed on one-year-old redbud plants revealed the pathogenic nature of all the tested isolates. This study explored the pathogenicity of the fungal species associated with canker disease on redbud, thus providing valuable information for developing disease management strategies in commercial redbud production.

**2:05-2:20** The potential application of bacterial endophytes in hemp production in Tennessee. **Mustapha Olawuni\*** and **Margaret Mmbaga**, *Tennessee State University, Nashville, Tennessee*. Common diseases affect crop production in southeastern states. Notably among them is southern blight caused by *Sclerotium rolfsii*. Scientists cautioned that excessive use of chemical pesticides is hazardous with residual effects on microbial diversity. Moreover, as a new crop, hemp is not included in pesticide labels. The use of bacterial endophytes for plant growth promotion and disease management has shown great potential as an alternative. Several bacterial endophytes were screened against *Sclerotium rolfsii* in vitro and three *Bacillus* species were selected out of which *Bacillus subtilis* and *Bacillus amyloliquefaciens* had the highest inhibition rate in dual culture experiments. Further studies in the greenhouse and field environment showed that plants treated with *Bacillus amyloliquefaciens* had less disease severity and displayed improved growth in shoot length and biomass. Record high temperatures in 2022 and 2023 summer affected field crops which demand integrated approaches that include agronomic practices and endophytes for disease management.

**2:20-2:35** Low-risk / no-risk insecticides effect on minute pirate bug (*Orius insidiosus*). **Yuna Gaire\***, **Kaushalya Amarasekare** and **Binita Sigdel**, *Tennessee State University, Nashville, Tennessee*. Using predatory natural enemies like *Orius insidiosus* is an effective and sustainable method to reduce arthropod pest populations in cropping systems. However, insecticide use can cause detrimental effects for some natural enemies, reducing their ability to provide biocontrol and ecosystem services or for inundated releases to achieve control. Thus, there is a need for compatibility studies before integrating pesticides with natural enemies. The objective of this study is to evaluate the effects of two low-risk insecticides, horticultural oil and insecticidal soap, on *O. insidiosus*. In this experiment, we evaluated eggs, nymphs, and adults of *O. insidiosus* treated with the high label rate and 10% dilution of high label rate of the two treatment insecticides and distilled water (control treatment) under laboratory conditions. The study shows significant adverse effects of horticultural oil and insecticidal soap on adults, nymphs, and eggs of *O. insidiosus*.

**2:35-2:50** Insectary plants as an alternative method for arthropod pest management in crop production. **Binita Sigdel\***, **Kaushalya Amarasekare**, **Firuz Yuldashev**, **Yuna Gaire**, and **Mariah McCullough**, *Tennessee State University, Nashville, Tennessee*. Insectary plants play a crucial role in conservation biological control by promoting eco-friendly pest management that aligns with Integrated Pest Management (IPM) principles by attracting beneficial arthropods. Multiple studies have been conducted on using insectary plants in other regions of the United States. However, their suitability as a pest management technique is still to be explored in the southeastern states, including Tennessee. Our objective was to evaluate the suitability of various flowering plants for attracting arthropod natural enemies using five flowering plant species: buckwheat, sunflower, zinnia, marigold, sweet alyssum, and a crop plant (green beans) as a control treatment. We conducted a field study in Nashville, Tennessee from May to September 2023. Plants were evaluated for natural enemies like lady beetles, flower flies, big-eyed bugs, etc. using plant tissue collection, beat sheet sampling, sweep net sampling, pitfall traps, and visual observation. We will discuss some of the results.

## Agriculture-Other Agriculture

Chair: TBA

1:00 pm – 2:50 pm

Ohlendorf 219

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

1:05-1:20 What factors influence the adoption of new production practices: Delphi study. **Daniel Morris\***, **John Ricketts**, **Alyssa Rockers**, **Thomas Broyles**, and **Jason de Koff**, *Tennessee State University, Nashville, Tennessee*. The purpose of this study is to determine what factors are most important for Tennessee farmers when considering adopting new technology. A Delphi study will be used to evaluate the most influential factors that farmers consider when adopting a new technology. A Delphi study utilizes a panel of experts who have extensive experience in their respective fields to formulate a consensus on what technologies are deemed to be important to agricultural producers. The experts will be chosen from their respective commodity boards in the state of Tennessee. The leaders of each commodity board will be asked to provide a list of experts for the Delphi Study. There have been studies conducted on the adoption of agricultural innovations and a comprehensive body of research detailing an array of factors influencing the diffusion of production practices among farmers (Kuehne et al., 2017). However, research has not been conducted that focused on Tennessee.

1:20-1:35 Man's best friend or best study buddy: student classroom performance and canine interactions. **Ainsley Watt\***, **Brittany Cole**, **Jason Roberts**, **Amber Moore**, *University of Tennessee at Martin, Martin, Tennessee*. Test anxiety is a common problem among college students and often leads to a decrease in performance on graded assignments. Universities are searching for ways to combat student performance anxiety to increase student success. This paper examines the influence of student and canine interactions on student performance on graded exams. We divide a sample of over 600 students into two statistically identical groups. One group engages in hands-on interactions with a dog before the exam, and one group does not. Using seven semesters of upper-level finance courses, we find students with animal interaction consistently score higher on graded exams.

1:35-1:50 What's ahead for land access and transfer opportunities in Tennessee? **Mary Mafuyai\***, **Abdelaziz Lawani**, **Arvazena Clardy**, and **Finis Stribling**, *Tennessee State University, Nashville, Tennessee*. According to the 2017 census of agriculture, there were 321,261 young farmers, under 25 years old, with 115 million acres, a 9 percent increase in the last 5 years. Eighty percent of the nations' young producers started farming in the previous 10 years. Ninety five percent of US farmers were whites; non-white farmers population grew between 2012 and 2017. This paper analyzes the prospects for Beginning, New, young and minority farmers to access and transfer farmland in Tennessee. The methodology consisting of secondary and primary data were used in developing the paper. A face-to-face and an online questionnaire were used in collecting pilot data from farmland owners in Tennessee. IBM statistics software was used in analyzing data collected. Qualitative and quantitative analyses were used in explaining the prospects for farmland access and transfer in Tennessee. Policy implications and recommendations are discussed. Project is funded by USDA/NIFA (Small Farms' Program).

1:50-2:05 The evaluation of *Lactobacillus Reuteri* and *Escherichia coli* Nissle as a potential probiotic for broiler chickens. **Morgan Roberts\***, **Samuel Nahashon**, **Thyneice Bowden**, *Tennessee State University, Nashville, Tennessee*. This study investigated the antimicrobial activity of two probiotic strains, *Lactobacillus reuteri* and *Escherichia coli* Nissle (*EcN*), against major *Salmonella* in vitro and the growth performance in broiler chickens. Both probiotics were added to the feed at 100 mg/kg. *L. reuteri* exhibited significant inhibitory activity against tested pathogens, while *EcN* showed none. Birds fed *L. reuteri* and *EcN* diets consumed 5.8% more feed than controls. Body weight gain was higher and feed conversion ratios were lower for birds in the *L. reuteri* and *EcN* groups compared to the negative control. Carcass characteristics were similar among groups, except for the fat percentage in the *EcN* group. In summary, supplementation with *L. reuteri* and *EcN* improved growth performance in broiler chickens, but these improvements were not reflected in carcass characteristics.

**Botany & Chemistry**  
**Chairs: Cassandra Fink & Dr. Xuanzhi Zhan**  
**1:00 pm – 3:20 pm**  
**Robertson 110**

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

**1:05-1:20** Synthesis of pyridyl-1,2,3-triazoles complexant scaffold via an intramolecular, DBU-mediated cyclization of n-tosylhydrazones. **Orume Edirin\***, **Jesse Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. A significant step in closing the nuclear fuel cycle is the ongoing identification of chemoselective complexants for the selective separation of minor actinides from lanthanides found in spent nuclear fuel (SNF). Minor actinides substantively impact the relative radiotoxicity of the SNF despite making about 0.1% of the mass of SNF. To transform the minor actinides into more stable, shorter-lived isotopes, they must initially be separated from the SNF, particularly from closely related trivalent lanthanides. Identification and production of N-donor complexants incorporating pyridyl-1,2,3-triazoles is the main goal of this project. The exploration of a metal-free cyclization of N-tosylhydrazones mediated by 1,8 Diazabicyclo(5.4.0)undec-7-ene, has been established. This method enables the production of pyridyl-1,2,3-triazole complexant scaffolds in good yield. Currently, 25 pyridyl-1,2,3-triazoles have been successfully synthesized using the optimized method in good yields. Preliminary substrate scope, functional group interconversion of significant substrates, method development, and optimization will be presented.

**1:20-1:35** Developing Cellular Assay to Evaluate the Efficacy and Specificity of JNK3 Isoform-specific Inhibitors with Therapeutic Potential for Neurodegenerative Diseases. **Nadia Mireku\***, **Xuanzhi Zhan**, **Sekyere Boateng\***, **Meagan Wharton\***, *Tennessee Technological University, Cookeville, Tennessee*. The c-Jun N-terminal kinase 3 is a JNK isoform that is mainly expressed in the central nervous system (CNS), and to a lesser extent in the heart and the testis. JNK3 is involved in the regulation of cell growth, cell division, apoptosis and survival. Accumulating data suggest the necessity of isoform-specific JNK inhibitors for therapeutic use to reduce the side effects of pan-JNK inhibition. Because of its CNS-specific distribution and pro-neuron death properties, the JNK3 isoform is an attractive therapeutic target for the treatment of neurodegenerative diseases. The development of a selective inhibitor for one isoform family of c-Jun N-terminal kinase remains a great challenge. A series of peptide inhibitors were recently developed which demonstrate great JNK3-isoform inhibition selectivity by targeting the specific interactions between JNK3 and its binding partners. The efficacy and selectivity of these new peptide-based inhibitors in cells must be carefully evaluated. Here, a number of cellular tests are proposed to study the inhibition of JNK3 activation by various cellular stimuli.

**1:35-1:50** Total Enantioselective Synthesis of Hamigeromycin B. **Victor Jonathan\***, **Jesse Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Resorcylic acid lactones (RALs) are a group of polyketide natural products characterized by the presence of a  $\beta$ -resorcylic acid and a 14-membered macrocycle. They have several biological properties that make them effective antibiotics, kinase inhibitors and anti-malarials. Hamigeromycin B is a more recent RAL thought to have kinase inhibitory properties hence this study attempts the total synthesis of hamigeromycin B. The retrosynthetic analysis involves two key synthons – a polyketide and a styrene acid. The polyketide synthetic strategy leverages hetero Diels-Alder [4+2] cycloaddition under the Jacobsen method followed by Conjugate addition. Ortho metalation of trimethoxybenzoic acid with halogen quench and then metal-mediated cross-coupling with a vinyl boronic acid is proposed to afford the styrene acid. The completion strategy proposes a ring closing metathesis and intramolecular macrolactonization of both synthons to afford hamigeromycin B. Synthetic progress on both synthons, attendant challenges, and completion strategy will be discussed in this presentation.

**1:50-2:05** Quantitative Analysis of Curcumin Released from Hydrogel Biomaterials. **Tammama Ferdous\***, **Madiha Syeda\***, **Tomoko Fujiwara**, *The University of Memphis*. Hydrogel biomaterials are three-dimensional-polymer networks designed to maintain stability while absorbing water. Created from monomers, prepolymers, and hydrophilic polymers, the hydrogel's structure is upheld through both physical and chemical crosslinking. Curcumin, a two-aromatic-ring system each with a hydroxy and methoxy group is known for its anti-inflammatory and antioxidant properties. The zinc-curcumin complex, 6-membered-ring-chelate with similar properties, can treat various medical conditions, including arthritis and forms of cancer. This research focuses on locally delivering curcumin by synthesizing a hydrogel. To facilitate the local delivery of curcumin using the hydrogel, release tests were conducted in varying pH buffer solutions, and UV-Vis was used to measure the released curcumin. Curcumin exhibits UV-Vis absorption in DMSO at 15 µg/mL, with a value of 2.858. The data was graphed in a Standard Curve format. This approach aids in determining the optimal concentration for targeted treatment while minimizing potential side effects within the human body.

**2:05-2:20** Synthesis of Pyridyl-1,2,3-triazoles Complexant Scaffold via an Intramolecular, DBU-mediated Cyclization of n-tosylhydrazones. **Orume Edirin\***, **Jesse Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. A significant step in closing the nuclear fuel cycle is the ongoing identification of chemoselective complexants for the selective separation of minor actinides from lanthanides found in spent nuclear fuel (SNF). Minor actinides substantively impact the relative radiotoxicity of the SNF despite making about 0.1% of the mass of SNF. To transform the minor actinides into more stable, shorter-lived isotopes, they must initially be separated from the SNF, particularly from closely related trivalent lanthanides. Identification and production of N-donor complexants incorporating pyridyl-1,2,3-triazoles is the main goal of this project. The exploration of a metal-free cyclization of N-tosylhydrazones mediated by 1,8-Diazabicyclo(5.4.0)undec-7-ene, has been established. This method enables the production of pyridyl-1,2,3-triazole complexant scaffolds in good yield. Currently, 25 pyridyl-1,2,3-triazoles have been successfully synthesized using the optimized method in good yields. Preliminary substrate scope, functional group interconversion of significant substrates, method development, and optimization will be presented.

**2:20-2:35** The New L-shaped Fourier Transform Microwave (FTMW) Spectrometer at Tennessee Technological University. **Rusiru Rajapaksha\***, **Mitchell Swann\***, **Cadence Miller\***, **Ranil M. Gurusinghe**, *Tennessee Technological University, Cookeville, Tennessee*. We are reporting progress on the development of a new Fourier transform microwave spectrometer at Tennessee Tech University. The new spectrometer combines two well-established pure rotational spectroscopic techniques, Cavity FTMW and Chirped Pulse FTMW, within one L-shaped vacuum chamber. The Cavity FTMW setup uses a Fabry Perot cavity formed using two 7.5-inch diameter aluminum mirrors to record high-resolution rotation spectra in the 8-18 GHz frequency range. The Chirped Pulse FTMW setup uses fast (<1 µs) frequency sweeps to record broadband rotational spectra in the 26.5- 40 GHz frequency range. The two FTMW setups are coupled with two independent molecular beam sources. The spectrometer will be used to investigate intrinsic molecular properties that include three-dimensional molecular geometry, weakly bonded van der Waals interactions, large amplitude motions, and nuclear quadrupole coupling of polar gas phase molecules and radicals.

**2:35-2:50** Efficient Synthesis of Unsymmetric, Pyridyl-1,2,4-triazines As Lewis Basic Complexant Scaffolds Toward Minor Actinide Separations. **Eric A. Agyei\*** and **Jesse D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Research in this lab continues to focus on the development of soft-Lewis basic complexant scaffolds for potential application in chemoselective liquid-liquid separations of trivalent actinides (An<sup>3+</sup>) from lanthanides (Ln<sup>3+</sup>) in spent nuclear fuel. Traditional ligand design utilizing the bis-triazinylpyridine (BTP) core has primarily centered on symmetric moieties of this class of molecules. The introduction of unsymmetric BTP scaffolds is proposed to have better solubility in inexpensive, process-relevant nonpolar diluents over the symmetric BTP scaffolds while retaining efficient separation. Exploration of these complexants will help define structure-activity relationships to improve complexant performance by revealing how variations in the molecular arrangements of the functional groups along the BTP core affect liquid-liquid separations of An<sup>3+</sup> from Ln<sup>3+</sup>. In this work, 20 examples of the proposed unsymmetric BTPs were afforded in good yields by

means of telescoped condensation of heteroaryl carbonitriles. The synthetic strategies toward relevant substrates will be presented.

**2:50-3:05** Synthesis of Ester-functionalized Bis-(1,2,4) triazinyl Pyridine(BTP) Complexants Toward Minor Actinide Separation of Spent Nuclear Fuel. **Samiat .O. Olayiwola\***, **Jesse .D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Nuclear energy has been established to be a reliable source of electrical power, However, the key barrier to the expansion of this power source is the management and disposal of these radioactive by-products of nuclear fission. The Spent Nuclear fuel (SNF) after separation contains a residual substance which is a mixture of <sup>241</sup>Am, <sup>244</sup>Cm, lanthanides, and other isotopes. Separation of An (III) from Ln (III) is challenging due to the similarities between the two groups. Prior synthesis in our group has afforded asymmetric and symmetric Mono-triazinyl pyridine (MTP) and Bis-(1,2,4) triazinyl pyridine (BTP) scaffolds, which had shown potentiality for this separation, this research work is centered on enhancing the performance of these scaffolds by introducing an ester functional group to these symmetric BTP scaffolds which could potentially modulate the performance of this tridentate ligand to allow for enhanced solubility and selectivity. Current synthetic results, characterization data, acid contact data, and solubility studies of these complexants will be presented.

**3:05-3:20** Progress Towards the Synthesis of Unsymmetric Tridentate Complexants for Application to Minor Actinide Separations. **Bolade R. Ajibola\* and Jesse D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Nuclear energy is distinguished for the generation of emissions-free power which is non-polluting to the atmosphere. Despite this pros of nuclear energy, the highly radioactive waste generated from spent nuclear fuel (SNF) as a result of the minor actinides (MA) being present needs to be effectively managed. The formation of an ideal complexant that will selectively separate MA from SNF is essential. Developing unsymmetric complexant scaffolds can be very explorative and has been hypothesized to improve challenges such as solubility difficulties and degradation challenges that have marginalized the efficiency of some symmetric complexants. With soft-Lewis basic unsymmetric complexants, substituents with different electronic properties can be introduced on both sides of the complexant which can aid the performance in separating MA from SNF. The synthesis of 1,2,4-monotriazinylpyridyl-1,2,4-triazole (MTP triazole) is currently in progress. Current synthetic results and future directions will be presented.

**Cell and Molecular Biology**  
**Microbiology**  
**Chair: Dr. Felicity Sterling**  
**1:00 pm – 2:20 pm**  
**Kennedy 205**

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

**1:05-1:20** Role of glycogen synthase kinase-3 in glucose homeostasis. **Bret P. Johnson\***, **Comfort Ogbu**, **Jacob J. Lemon**, and **Manisha Gupte**, *Austin Peay State University, Clarksville, Tennessee*. Glycogen Synthase Kinase-3 (GSK-3), a ubiquitously expressed serine threonine kinase under investigation for type 2 diabetes, certain types of cancer, and neurodegenerative diseases including bipolar disorder. Interestingly, GSK-3 has two structurally similar isoforms in mammals: GSK-3  $\alpha$ , a 51 kDa protein, and GSK-3 $\beta$ , a 47 kDa protein.. Previously, we have reported that GSK-3 $\beta$  KO mice fed a control diet (CD) for a period of 16 weeks exhibit improved glucose tolerance compared to the Control mice. In this study, we investigated the molecular mechanisms underlying improved glucose clearance in GSK-3 $\beta$  KO mice. Expression of Glycogen Synthase 2, a rate-limiting enzyme in glycogenesis, was increased in GSK-3 $\beta$  KO. Additionally, the expression of GLUT2, a predominant glucose transporter, was increased in livers from GSK-3 $\beta$  KO mice. Lastly, GSK-3 $\alpha$  expression was increased in GSK-3 $\beta$  KO mice. These results indicate that improved glucose clearance in GSK-3 $\beta$  KO mice may be from the contribution of increased glucose transport and glycogen synthesis.

**1:20-1:35** Investigating the effect of high-calorie and high-fat diet on genes associated with cognitive function in zebrafish. **Comfort Ogbu\***, **Tiana Nance**, **Manisha Gupte**, *Austin Peay State University, Clarksville, Tennessee*. An unhealthy diet has been shown to induce obesity with resultant cognitive dysfunction in mammals. Here, we investigated the effects of high-calorie and high-fat diet on the expression of genes associated with cognitive impairment in the prefrontal cortex of zebrafish (*Danio rerio*). We saw an increase in body weight with overfeeding and excess fat intake in the zebrafish after 14 weeks of feeding correlating with pathophysiological pathways underlying mammalian obesity. In quantitative real-time PCR analysis of the prefrontal cortex, ten genes were investigated. Increased expression of BACE1, PSEN1, PSEN-2 and caspase-1 were observed in high-calorie and high-fat fed group compared to the controls. Upregulation of these genes has been implicated in the accumulation of amyloid- $\beta^2$ , neuroinflammation and apoptosis. These changes are similar to those found in mammals fed high-calorie and high-fat diets. Thus, zebrafish is a feasible model to study the effects of obesity-induced by excess calories or high-fat diet.

**1:35-1:50** K1520I mutation in the C-terminal domain of topoisomerase II $\alpha$  alters catalytic activity. **Jeong Won Chang\***, **Daniel Ngabonziza\***, **Allison G. Jones\***, **Mattalyn R. Hardin\***, **Brooke D. Latham\***, **Addison K. O'Brian\***, **Clark E. Endsley\***, **Joseph E. Deweese**, *Department of Biological, Physical, and Human Sciences, Freed-Hardeman University, Henderson, TN 38340 USA (JWC, DN, AGJ, MRH, BDL, AKO, CEE, JED)*. *Department of Biochemistry, Vanderbilt University School of Medicine, Nashville, TN 32340 USA (JED)*. Topoisomerase II $\alpha$  (TOP2A) is an critical nuclear enzyme involved in regulating DNA topology during replication, transcription, and mitosis. TOP2A is an anticancer drug target due to the ability to abrogate cell growth and division when TOP2 is disrupted. The C-terminal domain (CTD) is an intrinsically disordered region of ~400 amino acids. The role(s) of the CTD are still poorly understood. Previously, we designed, purified, and examined eleven TOP2A CTD mutants to map regions of influence and function in the CTD. Here we report four additional TOP2A CTD mutants designed based upon biochemical and bioinformatic data. These four mutants included: P1317A; N1462I/R1463L (double-mutant); V1482D; and K1520I. All four mutants are catalytically active. All four also respond to etoposide-induced increase in plasmid DNA cleavage. Notably, K1520I displays reduced plasmid DNA relaxation, DNA cleavage and kinetoplast DNA decatenation activity. K1520I maps to a region known for chromatin interactions.

**1:50-2:05** Evaluation of the effect of lysine on the microflora of broiler chickens. **Thyneice Taylor-Bowden\*** and **Samuel Nahashon**, *Tennessee State University, Nashville, Tennessee*. Mediation of gut flora diversity and composition by the utilization of amino acids may have additional effects on host metabolism and health, this may provide prospective development of nutritional approaches for disease prevention/treatment. Lysine is the second limiting amino acid needed for breast muscle development which makes it an essential feed-additive. Consequences for the lack of lysine have a profound effect on potassium concentrations and poor nitrogen retention in poultry. Previously, we have identified 18 species in the gut of chicken belonging to the Lactobacillaceae family. *Lactobacillus reuteri* a gut bacterium for human, chickens, and other mammals was selected as an in vitro model to show various concentrations of lysine may alter chicken microflora. By observing *Lactobacillus reuteri*'s ability to thrive/survive various amounts of lysine in growth media has shown elimination of lysine or minimal amounts of lysine (0-0.14g) are not enough to sustain growth.

**2:05-2:20** Analysis of the tail assembly chaperone genes in the A-cluster Actinobacteriophages. **Madalyn Fallettii\***, **Elynor Fix**, **Levi J. Fritsch**, **Jackson T. Riedling** and **Dionicio Lopez**. *Columbia State Community College, Columbia, Tennessee*. Our objective was to genomically analyze the novel bacteriophage Dexes which belongs to the largest cluster of Actinobacteriophages – cluster A. Previously, we had annotated and published to the NCBI GenBank two other Actinobacteriophages of the A1 subcluster - Dussy and Manatee. The cluster A average genome size is 51,634 bp and the average number of genes in their genome is 90.5. Cluster A is divided into 20 subclusters with the largest, A1, including 195 members. Comparative analysis of the synteny in the phage Dexes genome with other genomes demonstrated that a programmed translational frameshift is localized in the Dexes tail assembly chaperone genes 23 and 24. We identified the conserved “slippery” nucleotide sequence GGGGAA by specifically searching for frameshifting sites across Dexes and the A1 phage genes. We conclude that the conserved slippery sites

represent an important component of the tail assembly mechanisms shared between phages with common ancestry.

**Ecology & Environmental Science  
Geology & Geography  
History of Science  
Science & Math Teaching  
Chair: Dr. Donald Shaw  
1:00 pm – 2:20pm  
Kennedy 205**

**1:00-1:05** Business Meeting – 4 section meetings will be held

**1:05-1:20** Environmental racism: The climate justice story of Nashville, Tennessee. **Leah E. Garrett\* and Reginald Archer**, *Tennessee State University, Nashville, Tennessee*. Nashville is facing storms, poor air quality, and urban heat, which are damaging public health. Climate change is impacting marginalized communities within Nashville. Despite the evidence of environmental inequality within communities an understanding of the connections between systemic racism and environmental inequality is minimal. Specifically, when it comes to these marginalized communities, there is little understanding of how the community is affected in comparison to other areas. Multiple research approaches such as story maps, survey data, and oral history of climate justice are used to gather information on environmental inequality. Results of this research show connections between marginalized communities and environmental injustices. Our objective was to evaluate marginalized communities having higher rates of respiratory illness, poor air/water quality, and higher temperatures due to lack of trees. Researching histories, education in climate justice, and organizations about climate justice must be formed to improve public health as climate change becomes dangerous.

**1:20-1:35** 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 North American bobcat, *Lynx rufus*, is found throughout the state of Tennessee. There are documented bobcat populations found across the state, but studies of actual numbers are over 40 years old. The objective was to evaluate a method of non-invasive bobcat hair sampling. Four hair traps with trail cameras were constructed and placed in four locations on the Lincoln Memorial University campus in Harrogate, Tennessee. The traps were constructed with plywood and contained a carpet sample soaked with bobcat urine. Gun brushes were placed along the insides to catch hair. The trap's tent-like shape allowed hair to be collected as the bobcat entered and brushed along the sides of the trap. Technical difficulties with certain cameras led to a lack of consistent photographic evidence, though one camera did capture images of a bobcat interacting with the trap. More research is required to determine the effectiveness of this method.

**1:35-1:50** Science needs for determining the impact of climate change on harmful algal blooms in Southeastern United States. **Tom Byl, Devin Moore\*, Champagne Cunningham\*, De'Etra Young**, *U.S. Geological Survey (TB), Tennessee State University (TB, DM, CC, DY)*. The southeast United States has many water resources that provide drinking water, recreational, commerce, agricultural, and ecological uses. Climate change is threatening the sustainability of these water systems. Harmful algal blooms (HABs) are emerging as a primary threat to the large and small waterbodies in the region. Understanding how climate change will affect the distribution and occurrence of HABs is vital to developing a management plan. The scientific literature describes parameters that may affect algal growth and toxin production, such as storm occurrence, temperature, dissolved metals, erosion of soils, length of growing season, and hydroperiod. We reviewed the literature and organized the information into three main drivers of HAB events – physical (hydroperiod, thermocline stratification, and length of growing season), biological (biogeography) and chemical (nutrients) parameters. The size and type of water body plays an

important role in how these parameters influence HAB development and will be discussed in the presentation.

**1:50-2:05** An inquiry-based, module approach to introductory biology laboratory for majors. **Jennifer T. Thomas and Rebecca L. Adams**, *Belmont University, Nashville, Tennessee*. Laboratory time in introductory biology courses has traditionally served as an opportunity to support content covered in lecture and to introduce students to skills and equipment used in the discipline. Lab exercises are often descriptive with results that are known and expected to students. With a curricular change at our institution, we began a revision process of our Principles of Biology I laboratory course that resulted in two overarching modules for the semester, Enzymes and Gene Expression, both of which center around the topic of the lactase enzyme, studied in vitro and in vivo. Within each module, students are introduced to basic content, experimentation, and skills followed by an “inquiry” element where students practice the process of science, including hypothesis development, experimental design, data analysis, and presentation through graphing. This presentation will highlight the components of this lab course and discuss the learning benefits of this approach.

**2:05-2:20** Utilization of the sterile insect technique to eradicate *Cochliomyia hominivorax*. **Rizpah Melton\* and Clint Ary**, *University of Tennessee at Martin, Martin, Tennessee*. A survey of the history of American agriculture reveals the many trials farms have faced regarding different parasites affecting their livestock resulting in production losses and welfare issues. Preceding the 1900s, screwworms had risen to such numbers that a horrific endemic had spread across the states. This threatened the agricultural economy by killing thousands of livestock across the nation and left ranchers and farmers struggling to find a solution for the ever-growing problem. Edward Knipling, a young entomologist, developed a remarkable scientific process for sterilizing male flies. They were then released back into the environment to reduce the breeding abilities of these parasites and give agriculture freedom from the endemic that plagued it. An overview of this parasitic issue and the scientific breakthrough in the history of agriculture will be presented with a focus on the eradication program that continues to this day.

## **Engineering & Engineering Technology**

**Chair: Dr. Vishwas N. Bedekar**

**1:00 pm – 2:05 pm**

**Briggs 108**

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

**1:05-1:20** Nanosatellite experimental solar cell and temperature sensor integration. **Damian Nguyen\***, **Jasper Scherz\***, **William Butler\***, **Jose R. Pastrana**, *Rhodes College, Memphis, Tennessee*. As the planned handover date for the RHOK-SAT satellite fast approaches, the payload team at Rhodes College begins the final integration of test components. RHOK-SAT is a nanosatellite collaboration project between Rhodes College and The University of Oklahoma. The goal is to integrate perovskite solar cells, a novel photovoltaic material, into a small satellite to be tested in space. The team also had to find ways to integrate many other components for the scientific mission. This presentation will focus on how we integrated two components and what we learned from the experience: Resistance Temperature Detectors (RTDs) measure the temperature of the perovskites and other components for correlation between performance and temperature; a CIGS (Copper, Indium, Gallium, Selenide) solar cell, a more conventional and well-characterized photovoltaic material, to act as the control cell and compare the perovskite performance.

**1:20-1:35** Reliable data flow design, data transmission, storage and maintenance for nanosatellite flight software. **Anas K. Matar\***, **Jose R. Pastrana**, **Marouf Mohammad Paul\***, **Zheng Yu Wong\***, *Rhodes College, Memphis, Tennessee*. Designing how data flows into, across, and out of a satellite comes with inherent challenges and risks caused by hardware limitations, mission requirements and a noisy



environment. Low memory constraints are of particular importance. Data reliability must be implemented in the flight software, and the ground station is required to handle packet loss, packet corruption, and high latency. Establishing a redundant storage solution grants fault tolerance for the satellite to manage and maintain the large amount of experimental data generated and stored on board. Designing a resilient maintenance lifecycle for the flight software is critical to lengthen the duration of the mission. This includes a second-stage bootloader, software update mechanism, and commands control.

**1:35-1:50** Nanosatellite circuit board design: testing and integration. **Jasper Scherz\***, **William Butler\***, **Damian Nguyen\***, **Jose Pastrana**, *Rhodes College, Memphis, Tennessee*. RHOK-SAT is a 1U (10 cm x 10 cm x 11 cm) nanosatellite with a mission to characterize perovskite solar cells in low Earth orbit. The mission payload was designed to fit in the nanosatellite, provide an electrical connection to the perovskites, and hold the measurement components. Two connected printed circuit boards (PCBs) were designed to contain the circuits and components needed to characterize the perovskite cells. One PCB contains a trigger circuit and a solar cell circuit which carries voltages to the measurement units. The second PCB contains the AMUs (Aerospace Measurement Units) used to measure the solar cells. Integrating the payload requires rigorous testing to ensure the PCBs work in accordance with the mission requirements.

**1:50-2:05** Dependence of emission composition on the experimental variables for anaerobic digestion of food waste and effects of microplastics. **Chance Perkins\***, **Tanmoy Acharjee\***, **Ngee-Sing Chong**, **Mina Mohebbi**, *Middle Tennessee State University*. Approximately 44% of food waste in the US is composted, anaerobically digested, or burned. One of the problems interfering with the efficacy of anaerobic digestion (AD) is the microplastics that are present in food waste via packaging and single use items. In this study, we investigate the effect of microplastic contamination on production of biogas in anaerobic digestion of food waste. We hypothesize that the presence of microplastics can alter the chemical and physical characteristics of AD system and alter the microbial population. Different food waste compositions and inoculum as sources for bacterial populations were tested. In analyzing the biogas content, we consistently detect carbon dioxide, water vapor, ethanol, methane, and trace levels of organic sulfur compounds. As the next step, by altering the polymer type, particle sizes, and different levels of plastic contamination in the food waste, we strive to understand the effects of microplastics on the AD process.

## **Health & Medical Sciences**

**Chair: Dr. Lilian Nyindodo**

**1:00 pm – 1:05 pm**

**Kennedy 207**

**1:00-1:05** Business Meeting -- There are no oral presentations in this section.

## **Math and Computer Science - 1**

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

**1:00 pm – 2:35 pm**

**Robertson 041**

**1:00-1:05** Business Meeting – combined with Math and Computer Science-2

**1:05-1:20** Greenhouse gas emissions in the US transportation sector. **Idris Ajibade\***, **Kayode Ogunsusi\***, and **Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Transportation is an integral part of modern society. However, the environmental consequences of transportation, particularly in terms of greenhouse gas emissions, have raised significant concerns in recent years.

According to Environmental Protection Agency, April 2022 report, in US, carbon dioxide emissions from transportation sector represents approximately 97% of the global warming potential of all greenhouse gas emissions. In the US, transportation sector accounted for 38% of the carbon dioxide emissions in 2021. In this study we discuss sources that determine transportation related emissions and trends. Also, we look at the various factors that will help in mitigating these emissions.

**1:20-1:35** Identify factors for cognitive impairment in elderly using support vector machine learning algorithm. **Olalekan M. Durojaye\* and Ramanjit K. Sahi**, *Austin Peay State University*. Elderly patients with serious cognitive impairment have a higher risk of progressing into Alzheimers Disease (AD). Hence, it is important to look at measures that will help in early identification for signs of patients with risk of cognitive impairment. Many research studies have used factors such as brain imaging, biomarkers, demographic etc. to show potential progression of cognitive impairment to AD. However, many of these models are very costly and not modifiable. Hence, our research focus is on using statistical techniques that are cost effective and adaptable in predicting factors in identification of signs of cognitive impairment very early among elderly people. In particular, we have applied support vector machine to predict the associated factors. The results show an accuracy of 70.5 % in predicting an early onset of impairment.

**1:35-1:50** Investigating spectral behavior through digraph move sequences. **Luke Guidry\***, *Rhodes College, Memphis, Tennessee*. In a recent paper Farsi, Proctor, and Seaton answered the question of spectral preservation for families of finite digraphs  $D$  under the application of six digraph moves. A digraph  $D$  is a finite collection of vertices connected by a finite collection of directed edges. In this presentation, we examine the question of the effect of some of these digraph moves on specific spectra of a finite digraph and investigate properties of these spectra under repeated performance of these digraph moves. We characterize the effects of the sequence of digraph moves (SSR) on the Symmetric Adjacency Spectrum and Binary Symmetric Adjacency Spectrum of a finite digraph  $D$ . We also construct two families of digraphs using this move sequence and give explicit formulae for computing the characteristic polynomials of digraphs within these families. Finally, we consider generalizations for this sequence of digraph moves and give further formulae for computing the resulting spectra.

**1:50-2:05** On the application of logistic regression to prime numbers. **Jackson Lewis\* and Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Prime numbers are a foundational part of many branches of mathematics and computer science, such as number theory and cryptography. Their study has led to many advancements in said branches and related fields. In this paper, machine learning was implemented to sort numbers into two categories: primes and composites. The algorithm used, logistic regression, simply takes the input list of numbers, trains with some percent of them, and then tests itself on the remaining percent to see how accurate it was. What makes this interesting however is that the algorithm isn't told what makes a number prime or composite, just which numbers are and which numbers aren't. The goal of this project was to try and determine how the algorithm was sorting the numbers into the two categories.

**2:05-2:20** Statistical and mechanical properties of sodium hydroxide treated palm kernel shell particles. **Paul C Madu\*, Ihueze Christopher, and Uchendu Onwurah**, *Austin Peay State University, Clarksville, Tennessee (PM) and Nnamdi Azikiwe University, Nigeria (IC, UC)*. Experiments were carried out to determine the mechanical and morphological properties of Palm Kernel Shell Particles Polypropylene (PKSP) composite as a filler in Polypropylene for pipe and fittings application. Natural fiber composite such as palm kernel shell are advantageous due to its biodegradability, low-cost and other advantages. This talk analyzes the mechanical and morphological properties of palm kernel polypropylene composite. Fourier Transform Infra Red characterization of palm kernel shell particles reveals functional groups that are present. Average crystallite value of treated PKSP is 34.865. Elements identified are Oxygen, Sulphur, Manganese, Beryllium and Silicon in treated PKSP specimens. The composite shows appreciable mechanical property in terms of Tensile strength, dielectricity and Hardness. Results from Taguchi analysis show the best composite formulation for optimum mechanical characteristics hence converting palm kernel shell particles agricultural waste to wealth.

**2:20-2:35** Study of U.S. crude oil prices and geopolitical factors. **Olayinka Ugwu\* and Ramanjit K. Sahi**, *Austin Peay State University, Clarksville, Tennessee*. My academic journey in the United States has kindled a deep interest in the American Oil and Energy industry, especially given the global energy

challenges linked to the Russia-Ukraine conflict. Consequently, my research is centered around the effect of geopolitical factors on forecasting of US Crude Oil Prices. We have applied statistical methods to study the patterns and trends in the prediction of crude oil prices. In our exploratory data analysis we see that the geopolitical forces have played a significant contribution and further support vector machine, (machine learning algorithm) has predicted great insights into the future of US crude oil prices.

**Math and Computer Science - 2**  
**Chair: Dr. Philip Kirlin**  
**1:00 pm – 2:35 pm**  
**Robertson 043**

**1:00-1:05** Business Meeting – combined with Math and Computer Science-1

**1:05-1:20** Event-driven architecture for nanosatellite flight software. **Marouf Mohammad Paul\***, **Jose R. Pastrana**, **Anas Matar\***, **Zheng Yu Wong\***, **Kamil Yousuf\***, *Rhodes College, Memphis, Tennessee*. Nanosatellites require flight software that is both efficient and responsive during orbital operations. RHOK-SAT is a nanosatellite testing the performance of perovskite solar cells in space. RHOK-SAT's flight software is built on top of a real-time operating system and was originally developed as a linear pipeline. In order to enhance flexibility, we are transitioning to an event-driven architecture (EDA). This shift is crucial for efficiently managing satellite transmissions, responding to various battery conditions, and making informed decisions for the scientific experiment. Using the real time timer (RTT) on board, we can set alarms and generate interrupts for specific events. Our approach to ground station communication shows this transition between architectures: the current epoch is used to schedule downlinks and switch the transceiver to transponder mode over the weekend. This approach eliminates constant resource-draining checks, allowing the system to respond directly to event alerts, conserving power and streamlining operations. Every significant occurrence, from battery status changes to communication requests, will be treated as an event, triggering specific actions within the system.

**1:20-1:35** Designing a bootloader for flight software update capabilities in orbit. **Jose R. Pastrana**, **Anas K. Matar\***, **Marouf Mohammad Paul\***, **Zheng Yu Wong\***, **Kamil Yousuf\***, *Rhodes College, Memphis, Tennessee*. Nanosatellite missions are ridden with risks. These risks translate into a need for thorough flight software testing and simulation. Yet, the possibility of failure can only be mitigated. The ultimate software fail-safe is the capability to update the system in case of faulty operations. In orbit, this process requires uplinking a new software image, validating it on board, writing it to memory, and booting from it. The most challenging aspect of the procedure is the booting mechanism, which requires the development of a second-stage bootloader to select the appropriate software image with which to run the system. The difficulty lies in the interactions of the bootloader with the on-board computer's ARM processor. The RHOK-SAT team has developed a proof-of-concept booting process that overwrites itself with a new software image, as would be required in practice. However, work remains to make this bootloader consistent and reliable.

**1:35-1:50** Building a reliable testing framework to verify nanosatellite's fault tolerance. **Kamil A. Yousuf\***, **Anas K. Matar\***, **Marouf M. Paul\***, **Zheng Yu Wong\***, **Jose R. Pastrana**, *Rhodes College, Memphis, Tennessee*. Ensuring a nanosatellite's fault tolerance is difficult since many of the conditions the satellite will experience in orbit cannot be recreated pre-launch. The interactions and responses of the flight software to these conditions must be verified before launch in accordance with mission requirements. The RHOK-SAT team decided to write an extensible testing framework that can simulate an in-orbit environment by emulating the satellite and dynamically setting subsystem conditions. This framework uses asynchronous subroutines to send data simulating the actions of the satellite subsystems to the emulated satellite image. The satellite's onboard controller is simulated using an emulator known as QEMU, which provides a means of running the satellite's software without the hardware. Using QEMU's virtual interfaces and false subsystem functions, the testing framework can send its generated data and conditions to the emulator, allowing us to test the flight software's handling of these conditions.

**1:50-2:05** Low bandwidth satellite communication. **Zheng Yu Wong\***, **Jose R. Pastrana**, **Marouf M. Paul\***, **Anas K. Matar\***, **Kamil Yousuf\***, *Rhodes College, Memphis, Tennessee*. Nanosatellite communication faces many challenges including restrictive bandwidth, lossy data transmission and difficulty with synchronization. This presentation surveys the methods used to create reliable data transfer despite these limitations. Restrictive bandwidth can be addressed through packetization and labeling, allowing data to be split up, transferred separately and reconstructed when received. Labeling, validation, and acknowledgement allows the software to address errors and missing pieces in the data. Data validation allows the software to confirm the identity of the sender, allowing an extra layer of security. We address the limited time for satellite and ground station communication using a global collaborative ground station network and provide the satellite a list of times when network stations will be within communication range.

**2:05-2:20** Integrating invariant functions via the hilbert embedding. **Lillian Whitesell\***, **Christopher Seaton**, **Hans Christian Herbig**, *Rhodes College, Memphis, Tennessee*. Using the Hilbert embedding, we want to create a way to integrate functions or differential forms that are invariant, or unchanging, with respect to a group action over subsets of vector spaces with singularities. By the Schwarz-Mather Theorem, smooth invariant functions on the vector space can be expressed as smooth functions of the invariant polynomials, and we will discuss the current progress on the question of how to integrate such functions on the image of the Hilbert embedding. This is known as the "canonical measure" or "canonical volume form" on the orbit space that pulls back via the Hilbert embedding to the ordinary volume form. I will present computations of this canonical measure in several cases where the action is coregular, as well as the work done so far towards generalizing the canonical measure.

**2:20-2:35** Computing formulae for Gamma-Orbifold Euler characteristics of  $O(2)$  representations. **Hannah E. Meit\***, *Rhodes College, Memphis, Tennessee*. Lie groups are, in essence, groups of continuous symmetries. Consider a circle; an arbitrarily small rotation will still preserve its structure. This "structure" is a somewhat abstract concept to consider until the group is assigned a representation. For our purposes, a representation is a combination of matrices that describe group actions, like rotations and reflections. Given a compact Lie group  $G$ , a finitely presented discrete group  $\Gamma$ , and a representation  $X$  of  $G$ , the  $\Gamma$ -orbifold Euler characteristic  $\chi_\Gamma(G \times X)$  is a topological invariant computed by determining the orbit types of  $X$ , each of their orbit spaces, the spaces of conjugacy classes of each isotropy, and the Euler characteristic of each of these components. We will discuss recent results in computing formulae for  $\chi_\Gamma(G \times X)$  with  $G$  as the group  $O(2)$  of  $2 \times 2$  orthogonal matrices acting on an arbitrary representation of  $O(2)$ , as well as the consequences of certain restrictions to  $G$ -invariant subsets of  $X$  and changes of  $\Gamma$ .

**Physics & Astronomy**  
**Chair: Dr. J. Allyn Smith**  
**1:00 pm – 3:05 pm**  
**Briggs 119**

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

**1:05-1:20** Effect of transducer distance on ultrasonic backscatter measurements of cancellous bone. **Blake C. Lawler\***, **Brent K. Hoffmeister**, **Ann M. Viano**, **Joel Mobley**, *Rhodes College, Memphis, Tennessee (BCL, BKH, AMV), and University of Mississippi, University, Mississippi (JM)*. Ultrasonic backscatter techniques may be used to detect changes in bone caused by osteoporosis and other diseases. These techniques are typically performed at peripheral skeletal sites and may place the interrogated region of bone tissue in the acoustic near-field of the transducer. The purpose of this study is to investigate how measurements in the near-field affect backscatter parameters used for ultrasonic bone assessment. Ultrasonic measurements were performed in a water tank using a planar 2.25 MHz transducer. Signals were acquired for five transducer-specimen distances:  $N/4$ ,  $N/2$ ,  $3N/4$ ,  $N$ , and  $5N/4$  where  $N$  is the near-field distance representing the transition from the near-field to far-field. Three

backscatter parameters were measured: AIB, FSAB, and FIAB. All three parameters depended on transducer-specimen distance with FSAB exhibiting the greatest dependence on distance. These results suggest that laboratory studies of bone should evaluate the performance of backscatter parameters using clinically relevant transducer-specimen distances.

**1:20-1:35** Measuring the temperature-dependent speed of sound of biomedically relevant fluids using ultrasonic pulses. **Grace I. Nehring\*, Emily E. Bingham\*, Brent K. Hoffmeister and Ann M. Viano**, Rhodes College, Memphis, Tennessee. Tissue specimens are commonly stored and ultrasonic measurements are made in phosphate buffered saline (PBS) solution and formalin solution. The goal of the study was to measure the speed of sound in these fluids over a 15.0 °C to 25.0 °C range. An aluminum block with a 0.500-in. machined step was placed in a 1 L specimen tank containing the fluid of interest. The specimen tank was positioned in a thermostatically regulated 8 L tank of water. A 7.5 MHz transducer was mechanically moved over the block to acquire echoes from either side of the step in 0.5 °C intervals. The time difference between echoes from each side of the step was measured to determine the speed of sound. The speed of sound was found to increase with temperature for both fluids, with ranges of 1484 m/s - 1512 m/s for PBS and 1509 m/s - 1532 m/s for formalin.

**1:35-1:50** An ultrasonic model for cortical and cancellous bone. **Kate Hazelwood\* and Brent Hoffmeister**, Rhodes College, Memphis, Tennessee. There is interest in developing ultrasonic techniques for diagnosing osteoporosis. Many techniques perform measurements at sites such as the heel, hip and spine where the bone tissue consists of a non-porous outer layer (cortical bone) that surrounds a porous interior region (cancellous bone). The goal of the present study was to develop a model that simulates this configuration. A block of polymer open cell rigid foam (OCRf) was partially embedded in a thin layer of clear casting resin to create the specimen. The resulting specimens were 40 mm  $\times$  40 mm  $\times$  20 mm with one 40 mm  $\times$  40 mm face embedded in  $\sim$ 3 mm of resin. Ultrasonic measurements were performed to characterize the speed of sound and attenuation of the resin and OCRf separately and together as configured in the specimen. The resulting specimens can be used to investigate how non-normal incidence may produce errors in backscatter measurements.

**1:50-2:05** Ultrasonic attenuation estimation within human scalp tissue. **Thomas Conroy\*, Blake Lawler\*, Brent Hoffmeister, Cecille Labuda, Ann Viano, Shona Harbert**, Rhodes College, Memphis, Tennessee (TC, BL, BH, AV, SH), University of Mississippi, Oxford, Mississippi (CL). Transcranial ultrasonic techniques are being developed for both diagnostic and therapeutic biomedical applications. Transcranial ultrasonic waves propagate through scalp, skull, and brain tissue. The ultrasonic properties of skull and brain tissue have been studied thoroughly, but the properties of scalp are less well known. The goal of the study was to determine if the ultrasonic attenuation of scalp, measured by calculating the frequency-slope of attenuation (FSA), varies through the thickness of the tissue. Eight specimens were prepared from four human cadaveric donors with ultrasonic measurements taken in a water bath at 37°C using a 7.5 MHz transducer. For the superficial region of scalp, FSA was determined to be  $(2.33 \pm 4.43)$  dB/cm/MHz compared to  $(1.99 \pm 4.76)$  dB/cm/MHz for the deep region of scalp suggesting the ultrasonic attenuation of scalp is similar for these two regions.

**2:05-2:20** Ultrasonic properties of fresh and formalin fixed brain tissue. **Amalia M. Bay\*, Grant R. Jenson, Brent K. Hoffmeister, Cecille Labuda, Ann M. Viano, Kate E. Hazelwood\*, Phyu Sin M. Myat\* and Blake C. Lawler\***, Rhodes College, Memphis, Tennessee, and The University of Mississippi, Oxford, Mississippi. This study investigates the effect of formalin fixation on the ultrasonic properties of brain. Slices of tissue were prepared from 9 bovine brains with a total of 28 slices (16 sagittal, 12 coronal). Specimens were scanned in physiologic saline with a 5 MHz transducer. Scans were performed on fresh tissue and repeated one month after formalin fixation. Speed of sound (SOS) and frequency slope of attenuation (FSA) of ultrasonic pulses propagated through the tissue were determined at every measurement site and then averaged to obtain the following results expressed as mean  $\pm$  standard deviation. SOS was  $(1522 \pm 3)$  m/s before fixation and  $(1538 \pm 12)$  m/s after fixation. FSA was  $(0.438 \pm 0.064)$  dB/cm/MHz before fixation and  $(0.493 \pm 0.113)$  dB/cm/MHz after fixation. Thus, formalin fixation produced approximately a 1% increase in SOS and a 13% increase in FSA.

**2:20-2:35** Locked and slipping transport of microparticles on permalloy disks: describing particle motion using micromagnetic simulations. **Gregory Vieira, Eliza Howard\*, Chris Hoang\*, Ryan Simms\***,

**Prannoy Lankapalli\***, **Evan Duet\***, **Iesha Phillips\***, **Keith Hoffmeister\***, *Rhodes College, Memphis, Tennessee*. We investigate the motion of micro-scale superparamagnetic particles transported across arrays of micro-scale permalloy (Ni<sub>0.8</sub>Fe<sub>0.2</sub>) disks driven by varying, weak (<100 Oe) magnetic fields. These fluid-borne particles are often used for bioseparation, as they can be bound to desired targets which can be isolated from mixtures by purification using external magnets. We investigate physical properties “both the particles’ magnetic susceptibilities as well as the magnetic properties of the permalloy disks” by transporting particles across disk arrays, and in particular, by investigating locked versus slipping motion of mobile particles. Necessary for accurately describing particle motion is a vortex magnetization landscape for the disks yielding stray fields that are significantly smaller than would be obtained from disks which are fully or nearly fully magnetized. We simulate these magnetization landscapes using the Object Oriented Micromagnetic Frameworks and discuss the in silico experimental conditions that match experimental results.

**2:35-2:50** Design and Implementation of a Sun Sensor for a Nanosatellite. **William Butler\***, **Jasper Scherz\***, **Damian Nguyen\***, **Kairos Wong\***, and **Jose Pastrana**, *Rhodes College, Austin, Texas*. A TO-5 quad-photodiode sun sensor is used to determine when sunlight is illuminating RHOK-SAT’s experimental solar cells (perovskites). Testing the efficiency and lifespan of these novel cells is the satellite’s primary scientific mission. Measurements consisting of current-voltage pairs are taken while the cells are illuminated. These measurements must be triggered when sunlight is within a 25-degree angle relative to the face of the cells. Our tests show that repeatability becomes an issue when the angle exceeds 25 degrees. The angle measurement is the function of the sun sensor. A square aperture is necessary to create a spot on the photosensitive material. A circular pinhole with a diameter larger than the square aperture is placed above the aperture to reduce noise and the need for a baffle tube. The sun sensor must be calibrated on the ground to accurately measure sunlight angles, simulating the satellite slowly tumbling in space while in orbit. These design choices and calibration tests are necessary for post-launch data processing as they provide a basis for the satellite’s operability in low Earth orbit.

**2:50-3:05** The color calibration of the dark energy survey. **J. Allyn Smith**, **Douglas L. Tucker**, **Sahar S. Allam**, **Sean Peete\***, **Meagan N. Porter\***, **William Wester**, *Austin Peay State University, Clarksville, Tennessee (JAS, SP, MNP)*, and *Fermilab, Batavia, Illinois (DLT, SSA, WW)*. The Dark Energy Survey (DES), is imaging one-quarter of the Southern sky down to an apparent magnitude of  $i \sim 24.5$ . The survey observations were conducted with a 3-square-degree wide-field CCD mosaic camera (the Dark Energy Camera, or DECam) on the Blanco 4-meter telescope at the Cerro Tololo Interamerican Observatory in the Chilean Andes, between 2013 and 2019. The primary scientific goal of the DES is to measure properties of Dark Energy. To achieve its science goals, the DES had tight requirements on both its relative and absolute photometric calibrations. The requirements for the completed survey are (1) an internal (relative) photometric calibration of 2% rms (2) an absolute color calibration of 0.5%, and (3) an absolute flux calibration of 0.5% (in  $i$ -band relative to BD+17:4708). We present an overview of the calibration process and all the various pieces which come together to achieve the accuracies which were our target.

## Zoology

Chair: **Dr. Julie Baker Phillips**

**1:00 pm – 2:05pm**

**Kennedy 208**

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

**1:05-1:20** Evaluation of *Camellia sinensis* anxiolytic effect in *Danio rerio*. **Krista Meredith\*** and **Marybeth Babos**, *Lincoln Memorial University and DeBusk College of Osteopathic Medicine, Harrogate, Tennessee, Tennessee*. The primary aim of this project is to evaluate the efficacy of *Camellia sinensis* (green tea) as an anxiolytic using zebrafish (*Danio rerio*) as a model organism. Anxiolysis will be determined using the novel dive tank test, a well-established test for anxiety in zebrafish. To the best of our knowledge, extract of green tea has never before been tested for anxiolysis, though the green tea

constituent L-theanine has. Additionally, we will establish the dose-response relationship of the anxiolytic effects of green tea should they exist. The purpose of examining green tea in zebrafish is to determine if there is a dose-response curve. If the curve is positive, there is reason to believe the green tea can be used in humans to reduce anxiety.

**1:20-1:35** Use of eDNA to determine the presence of *Cryptosporidium* spp. in freshwater sources in Harlan, Kentucky. **Madison Hall\***, **Barbara Shock**, **Whitney Kistler**, **Logan Taylor\***, *Lincoln Memorial University, Harrogate, Tennessee*. *Cryptosporidium* spp. oocysts are transmitted via a fecal-oral route, e.g., water sources, and the parasite is a leading cause of waterborne disease in the United States. Research into Cryptosporidiosis in rural areas is lacking. This study utilized eDNA methods to determine if *Cryptosporidium* spp. is present in Harlan, Kentucky, an underserved area in Appalachia. We used a pump-powered system to filter freshwater sources and collect eDNA onto filter paper. Samples were collected from tap and spring water, and three tributaries of the Cumberland River: Martins Fork River, Poor Fork River, and Clover Fork River. eDNA was extracted from the filter paper and a genus specific *Cryptosporidium* PCR is being utilized to determine the prevalence of *Cryptosporidium*. Sanger sequencing is ongoing to confirm the PCR findings and determine *Cryptosporidium* species. These data may be informative for public health in Appalachia by identifying potential risks along accessible waterways.

**1:35-1:50** Trophic morphologies of female map turtles (*Graptemys* spp.). **Michael C. Fulbright**, *Cumberland University*. The genus *Graptemys* is comprised of fourteen species found throughout North America. In all fourteen species, there is pronounced sexual size dimorphism, with females that are typically 2-3 times larger than their male conspecifics. Females of the genus can be characterized as being either microcephalic, mesocephalic, or megacephalic based on their trophic morphology. Differences in head shape are putatively correlated with differences in feeding performance and resource partitioning. I evaluated performance differences in the feeding morphology of microcephalic Sabine map turtles and megacephalic Pearl River map turtles. I measured bite forces and handling time of food items between species and quantified anatomical differences in the craniofacial muscles of the two species. I found that megacephalic turtles generated significantly higher bite forces than microcephalic congeners and other previously studied turtle species. I also found that microcephalic females may have the adaptive advantage of precision feeding compared to their larger-headed congeners.

**1:50-2:05** Annual variation in nesting success of Ruby-throated Hummingbirds. **T. David Pitts**, *University of Tennessee at Martin, Martin, Tennessee*. During the 13 years of 2011-2023 I studied nesting success of Ruby-throated Hummingbirds (*Archilochus colubris*) in woodlands surrounding my rural home in Weakley County, Tennessee. Throughout each nesting season (April - August) I searched for nests and then monitored the nests I had discovered until either the young fledged or the nesting attempt failed. I monitored an average of 20.9 nesting attempts (range 11 - 30) each year. Overall, 106 of 271 (39.1%) nesting attempts were successful (i.e., fledged at least one nestling). Annual nesting success (percent of nesting attempts that were successful each year) varied from 7% to 71% and peaked at 5-year intervals in 2011 (64%), 2016 (58%), and 2021 (71%). I suspect most failures were due to predation either by birds or by small mammals such as Southern Flying Squirrels (*Glaucomys volans*). Explanations for possible 5-year cycles of nesting success remain speculative.

# Poster Presentations

## Bryan Campus Life Center

### Agriculture Posters

**1-01** Perception of Animal Husbandry Differences between the United States and the British Isles. **Chloe Dobson\* and Diana Watson, J. Ross Pruitt**, *The University of Tennessee at Martin, Martin, Tennessee*. International travel studies have proven to be attractive to undergraduate students, allowing them to experience other cultures, languages, foods, and traditions. In the spring of 2023, agricultural students from the University of Tennessee at Martin participated in a two-week agriculture-focused trip to the British Isles. Students experienced the differences in animal husbandry techniques while interacting with livestock producers. This study analyzes perceptions of animal husbandry techniques between the U.S. and countries visited in the British Isles through a pre- and post-trip evaluation. Results analyze the knowledge gained and how the trip changed student perceptions of animal husbandry differences between the U.S. and countries in the British Isles.

**1-02** Household Green Consumption Behavior of Agri-Food in Tennessee: A Subjective Measurement Model. **Doc L Tran and Prabodh Illukpitiya**, *Tennessee State University, Nashville, Tennessee*. The increasing concerns about environmental sustainability and supporting local communities have resulted in a growing interest in green consumption behavior. This study investigates household green consumption behavior regarding agri-foods in Tennessee. The objective is to develop a measurement model to understand consumers' attitudes, awareness, and willingness to pay for organic and locally grown organic foods. By integrating the constructs of Ecological Citizenship Theory, Social Identity Theory, and Theory of Planned Behavior into a theoretical framework, we propose a model for measuring household green consumption behavior. This model enables us to examine how individuals' perceptions and beliefs influence their intentions and behaviors to purchase locally grown food. The model contributes to the existing literature by providing insights into consumer preferences and promoting environmentally practices that support local communities. It offers a tool for policymakers and stakeholders in devising effective strategies to encourage green consumption behaviors and bolster local small-scale farming practices.

**1-03** Examining financial literacy among college students of agriculture and business. **Brittany Cole, Rachna Tewari, and Joey Mehlhorn**, *University of Tennessee at Martin, Martin, Tennessee*. The cost of college and student loan crisis has dominated the news in higher education. As student loan practices and rising tuition are being scrutinized by parents, students, and politicians it is important to determine student perceptions of financial management and develop a baseline for student understanding of financial literacy. Even though personal finance has been a requirement in Tennessee high schools for years, it is still apparent that students are not fully retaining the knowledge as they reach college. A student assignment was developed in fall 2023 to assess student knowledge focused on personal finance, understanding of the student loan process, and views on cash management. Results were mixed among students primarily based on academic major and college classification. Students are adept at using digital banking applications and aware of personal identity issues related to the financial industry.

**1-04** Developing Pathways for Agricultural and Environmental Law Opportunities for Undergraduates. **Joey Mehlhorn and Anthony Delmond**, *University of Tennessee at Martin, Martin, Tennessee*. Undergraduates have many options available for traditional careers in agriculture and natural resources. Universities have done a great job of providing traditional pathways such as animal and plant sciences; agribusiness; environmental science; agricultural engineering technology. While these programs have been around for many years, they do not fully provide options for students looking to study law and policy. The University of Tennessee at Martin has worked to develop a new program based on agriculture student requests for specialized training for applying to law school after completion. This new endeavor was not without hurdles and issues but has potential to meet a growing demand by students and retain more agriculture students. Issues such as program development, employment outlook, and multi-department collaboration are discussed. It is essential to have early



planning and buy-in from all groups involved. This exercise will be beneficial for anyone looking to develop a non-traditional agriculture curriculum.

**1-05** Factors affecting the choice of direct marketing strategies: findings from small farmers in Tennessee. **Purushottam Dhungana\***, **Aditya R. Khanal**, and **Sujan Ghimire\***, *Tennessee State University, Nashville, Tennessee*. Choosing the right marketing channel or combination of channels is a crucial decision that could remarkably impact farm income. Common ways of selling farm products include direct marketing channels and intermediate channels. Using primary data collected from 221 small farmers and a multinomial regression model, we determine the factors affecting the choice of direct marketing strategy. We observe that the majority of small-scale farmers primarily rely on direct on-farm sales and farmers' markets to market their products. However, a small proportion of these farmers also utilize intermediate channels like wholesalers, retailers, and contracts, in addition to on-farm sales and farmers' markets for marketing. Additionally, small-scale farmers operating on larger landacre and employing diversification strategies such as organic farming are inclined to utilize a combination of both direct and intermediate marketing channels and often employ a greater variety of marketing channels as well.

**1-06** Evaluating animal health perspectives across different cultures. **Mackenzie Moody\***, **Molly Campbell\***, **Rebecca Varneke\***, **Sandy Mehlhorn**, **Diana Watson**, *University of Tennessee at Martin, Martin, Tennessee*. With this evermore connected world, it is important to understand the cultural differences associated with animal agriculture. Recently, University of Tennessee at Martin students participated in travel studies to Kenya and Guatemala. While there, they conducted surveys to analyze the various perspectives concerning animal management among local residents. Participants were asked questions pertaining to types and number of species owned, use of veterinary care, feeding practices, and prevalence of disease. Between the two countries, the greatest difference was noticed between the type and number of species owned. Kenyan survey participants reported more livestock ownership compared to Guatemalan participants who reported more companion animal ownership. However, similarities were observed in areas such as veterinary care and nutritional management. One interesting difference noted was the cultural status associated with owning livestock in Kenya that was unseen in Guatemala.

**1-07** Assessing the biocontrol potential of oyster mushroom (*Pleurotus* spp.) mycelium against soybean cyst nematodes (*Heterodera glycines*). **Niraj Ghimire\***, **Ali Taheri**, **Zeinab Yadegari** and **Lesley Schumacher**. *Tennessee State University, Nashville, Tennessee (NG, AT) Fisk University, Nashville, Tennessee (ZY) and Research Plant Pathologist – Nematologist, USDA-ARS (LS)*. Soybean cyst nematode (SCN) is a microscopic, parasitic roundworm that poses a significant threat to soybean crops worldwide. Controlling soybean cyst nematodes through biological means is a crucial aspect of integrated pest management. A recent study discovered that filamentous structures (hyphae) of oyster mushroom quickly paralyze and kills 17 nematode species (including *Caenorhabditis elegans*) upon contact. The oyster mushroom and related species employ a highly conserved predatory mechanism to paralyze and kill nematodes targeting their cilia, offering a novel approach for controlling parasitic nematodes in various organisms. No previous report is available on the effects of this mushroom on SCN. In this experiment, we exposed juvenile SCN to oyster mushroom mycelium grown in the petri plate, but no paralysis occurred. Nematode movement was recorded under microscope for 30 minutes. *C. elegans* juveniles used as positive control were paralyzed under 2 minutes, suggesting that SCN is resistant to *Pleurotus ostreatus*.

**1-08** Assessing the disease management practices of dogwood production in the Tennessee nursery industry. **Kumuditha Hikkaduwa Epa Liyanage**, **Anthony Witcher**, **Aditya Khanal**, and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Accurate detection of diseases and implementation of efficient disease management practices are vital in reducing the economic impact associated with plant disease outbreaks. This study examined factors that how nursery growers perceive the challenges, and perceptions of disease management of dogwood production in Tennessee. Survey link of the questionnaire was sent to sixty-two dogwood nurseries via email. According to the results, the majority of growers scouted for diseases in field-grown and pot-in-pot plants weekly and container plants daily. Significant positive correlations were observed between disease severity and scouting frequency for container and pot-in-pot plants. Eighty-nine percent of growers followed a set fungicide spray schedule

between May and October and sprayed fungicides every other week. The efficacy of disease management is positively associated with the overall cost of foliar fungicide applications. Exposure to new detection and control methods is important to reduce the cost of labor-intensive disease management practices of dogwood nurseries.

**1-09** The management of major flowering dogwood diseases by evaluating current practices and emerging strategies. **Christina Jennings\***, **Fulya Baysal-Gurel**, and **Prabha Liyanapathiranage**, *Tennessee State University, McMinnville, Tennessee*. Flowering dogwood (*Cornus florida* L.) is a commonly used ornamental species. Tennessee is the number 1 dogwood seller in the US which accounts for over \$7 million in sales. Some common diseases, such as powdery mildew and *Phytophthora* root rot, can threaten dogwood plants in container or field production nurseries. The purpose of this study was to evaluate different biorational products, biofungicides, fungicides, or plant defense inducers against powdery mildew and *Phytophthora* root rot of dogwood. Two separate experiments were conducted for each disease using flowering dogwood 'Cherokee Princess' plants in a completely randomized design. Powdery mildew incidence was determined by percentage of foliage affected and root rot was determined using a scale of 1-5. All treatments significantly reduced powdery mildew and root rot incidence compared to non-treated control plants in their respective trials. The findings of this study will help nursery growers in the management of significant dogwood diseases.

**1-10** Management of crown gall disease of roses using biological control agents and chemical treatments. **Cansu Oksel**, **Prabha Liyanapathiranage**, **Farhat A. Avin**, **Madhav Parajuli\***, **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Crown gall, caused by *Agrobacterium tumefaciens*, is an important bacterial disease of roses. In this study, the effectiveness of biocontrol agents and chemical treatments in controlling rose crown gall was assessed. A randomized complete block design was used, with each treatment replicated ten times in two individual trials. The crown and root region of each plant were wounded and dipped in treatment for 15 min. Plants were inoculated with *A. tumefaciens* inoculum by drenching bacterial suspension (109 CFU/ml) at the base of the plants. Roses were kept in a greenhouse for six months and the crown gall formation was evaluated. All treatments reduced the average diameter of the root and crown galls compared to the control plants in both trials. Nogall and Galltrol A strains 1 and 2 resulted in the lowest average root gall diameter. These findings provide useful information for the effective management of rose crown gall disease.

**1-11** 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, often referred to as the "hidden half" of plants, are pivotal for plant development. Global warming disrupts soil properties, impacting root function and, consequently, plant growth. Our study focused on seven Root System Architecture (RSA) traits in 500 soybean accessions. Seeds were germinated on specialized paper, later transferred to blue blotting paper, and root imaging occurred 21 days post-transfer via RootNav2.0 software. Utilizing root phenotypic data and SNPs from the SoySNP50K iselect, we performed Genome-wide Association Studies (GWAS) on two platforms: TASSEL 5.0 (MLM and GLM) and FarmCPU. Both platforms identified 53 distinct SNPs associated with these traits, with chromosome 13 presenting the most significant SNP findings. Additionally, we developed CRISPR vectors using soybean-specific promoters for future genome editing of root traits. These results are poised to unlock new QTLs or genes, facilitating the breeding of innovative soybean cultivars better suited to changing climates.

**1-12** Approaches towards mitigating vascular streak dieback; the novel threat to redbud nursery production in the southeastern United States. **Prabha Liyanapathiranage\*** and **Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Vascular streak dieback (VSD) is the current terminology used to describe redbud plants that exhibit a commonly reported set of symptoms including leaf scorching, tip dieback, and vascular streaking. Even though the causal agent(s) of VSD has not been confirmed yet, *Ceratobasidium theobromae* has been identified both molecularly and morphologically and has always been associated with VSD symptomatic redbuds. A fungicide efficacy trial and a cultivar screening were conducted in McMinnville, TN in 2022 with redbud plants that were naturally exhibiting VSD-related symptoms. Foliar application of Postiva at 20 fl oz/100 gal and Mural at 7 oz/100 gal in 14-day application intervals were the most effective treatments in reducing leaf scorching severity and none

of the tested cultivars exhibited 100% resistance to VSD during the growing season. These results will be beneficial for the nursery producers to make management decisions for this novel threat that affects redbud production in the region.

**1-13** Effect of substrates and nitrogen rates on the yield performance of organic kale and Swiss chard in a vertical growing system. **Andruw Jones, Sochinwechi Nwosisi, Sai Prakash Naroju, Saidullah Chowdhary, Anthony Witcher and Dilip Nandwani\***, *Tennessee State University, Nashville, Tennessee*. This study evaluated the effects of the various substrates and nitrogen rates on kale and swiss chard. Four substrate combinations, Peat moss and Perlite (80:20), Pine bark and Peat moss (70:30), Pine bark and Compost (70:30) and Pine Bark and Coffee Chaff (70:30) used. Each vertical tower installed with four stackable pots, total 16 plants in each tower, 4 plants/pot. Four treatments of nitrogen were applied to the plants, control (6-12-28), control + 7.5% N, N and control + 30% N. Data collected on plant growth, height, leaf length, fresh weight and dry biomass, and total soluble solids. Pine bark-peat moss mixture showed superior yield in Kale (551.66/g). The substrate mixture of peat moss and perlite produced highest yield in Swiss chard (553.59/g). Control plus 30% nitrogen treatment produced higher yield in kale (688.64/g) and Swiss chard (764.93/g). Preliminary data provided valuable information on the use of substrate selection and nitrogen rates.

**1-14** Effects of physico-chemical poultry drinking water quality parameters on the nutrient digestibility and performance of broiler chickens. **Rabin Raut, Thyneice Bowden, Agnes Kilonzo-Nthenge, Bharat Pokharel, Samuel Nahashon, and Pramir Maharjan**, *Tennessee State University, Nashville, Tennessee*. Water is a critical nutrient for poultry, significantly influencing their health and digestion. Poultry typically consumes double the amount of water compared to feed by weight. Poultry drinking water quality is tied to natural sources like wells, drilling, and tanks, involving pH, TDS, and nitrate levels. However, limited research investigates the impact of water pH, nitrate, and TDS on broiler chickens' nutrient digestibility and health. This study aims to assess these parameters' effects on broiler chickens by collecting water samples from a potentially contaminated area in Nashville, Tennessee. Water pH, TDS, and nitrate levels will be measured with a pH meter, TDS meter, and spectrometric techniques respectively, and bird mortality rates will be analyzed. We'll analyze bird mortality rates and use Pearson's correlation to find any relationships. Apparent nutrient digestibility will be evaluated using a formula. This research informs poultry producers on optimizing water quality for better welfare and productivity.

**1-15** Use of pheromones to manage cucumber beetle (Coleoptera: Chrysomelidae). **Kaushalya G Amarasekare, Firuz Yuldashev, Yuna Gaire, Binita Sigdel, Sarah Kilcoyne, and Mariah McCullough**, *Tennessee State University, Nashville, Tennessee*. Damage caused by striped and spotted cucumber beetles is a critical problem for cucurbit growers, especially for organic growers and small farmers. Although most of these farmers follow integrated pest management (IPM) practices and use insecticides sparingly, managing cucumber beetles is still a significant problem. In addition, organic growers have only a few OMRI-approved insecticides for pest management. Thus, there is a need to find cost-effective, environmentally sound IPM practices to manage cucumber beetles. An effective trapping method is a sustainable pest management practice for conventional and organic cucurbit growers. This study aimed to find the effectiveness of a commercially available lure/attractant as a trapping method for cucumber beetle management. We used cucumber as our target crop to evaluate the season-wide effectiveness of the lure on trapping cucumber beetles in 2022. Seventy-two percent of the cucumber beetles collected from traps were striped cucumber beetles. We discuss the results in detail.

**1-16** In vitro isolation of microspores at different developmental stages for snp profiling in sorghum to uncover bioremediation traits. **Ahmad Aziz and Dilovan**, *Tennessee State University, Nashville, Tennessee*. Sweet sorghum is a well-known multifunctional crop that can be used for food, forage, and as a possible biofuel feedstock is farmed in the United States (for syrup). To enhance its bioremediation traits, this study focuses on the isolation of microspores at various developmental stages and employs single Nucleotide Polymorphism profiling. Sorghum is cultivated under controlled conditions, ensuring uniform developmental stages. Microspores are extracted at various developmental stages (tetrad, uninucleate, and binucleate stages) allowing for a comprehensive genetic analysis. Data analysis involves SNP calling, and statistical analyses to genetic variations across microspore developmental stages. Despite the limited SNP data, particularly at the microspore stage, this research aims to bridge

the gap by uncovering unique genetic variations that could contribute to enhancing the sorghum plant's bioremediation capabilities. This study lays the foundation for harnessing the full potential of sorghum in bioremediation, furthering its application in sustainable agriculture and biofuel production.

**1-17** Eco-types of pigweed and Johnsongrass in Tennessee exhibiting herbicide resistance. **Ahmad Aziz, Rafeq Jambi, and Nayidu Naghbushana**, *Tennessee State University, Nashville, Tennessee*. Weed resistance to different types of herbicides is currently the main issue, despite the development of management strategies for them in the past. Weeds like amaranth and Johnson grass are growing more active and resistant to herbicides, endangering the safety of the world's food supply. Understanding these weeds various resistance mechanisms may be crucial for efficient control. The complex procedure for this adaptive feature would necessitate the discovery of key metabolic pathways including acetolactate synthase and glyphosate resistance mechanisms. This led to the collection of three samples of each plant, sorghum and amaranth, from 41 counties in Tennessee: 15 in the west, 10 in the east, and 16 in the middle. On some of these collections, herbicides including Sharpen, Duracore, and Round-up were reportedly utilized. DNA samples are now taken from each accession and measured using an average uv230/260 ratio of 1.5 and 36.24 ng/. towards next genetic analyses yields.

**1-18** The evaluation of *Lactobacillus reuteri* and *Escherichia coli* Nissle as a potential probiotic in broiler chickens and the potential inhibition of *Salmonella* spp. in vivo. **Morgan Roberts, Samuel Nahashon, and Thyneice Bowden**, *Tennessee State University, Nashville, Tennessee*. The objective of this study is to investigate the efficacy of utilizing a freeze-dried version of the bacteria *Escherichia coli* strain Nissle (EcN) and *Lactobacillus reuteri* (*L. reuteri*) as probiotics within the context of animal health management, with one of the focuses being on reducing the prevalence of *Salmonella* spp. in broiler chickens in vivo. Results TBD.

**1-19** Comparison of macro and micromineral levels in forage versus goat serum and manure. **Jared Henson\* and Clint Ary**, *University of Tennessee at Martin, Martin, Tennessee*. This study aimed to develop a better understanding of dietary mineral needs in goats throughout the grazing season in northwest Tennessee. Mineral levels in forages vary during the grazing season which can possibly lead to excesses or deficiencies directly impacting the health of an individual animal or herd. Identifying times of the season when certain minerals are low may allow producers to substitute these nutrients to their herd more precisely and economically. Blood serum, fecal, and forage analysis was conducted each month from May to September. The minerals assessed in the study were calcium, phosphorus, magnesium, potassium, copper, zinc, and iron. Phosphorus and magnesium increased during the season in blood serum, fecal, and forage samples. This correlation could indicate the need to supplement phosphorus and magnesium early in the grazing season to avoid serum mineral deficiencies.

**1-20** Gen Z perception of agricultural biotechnology. **Anthony R. Delmond, Jordyn Litton\*, Chloe Ragland\*, and Jordan Stringfield\***, *University of Tennessee at Martin, Martin, Tennessee*. The U.S. is particularly progressive in its utilization of agricultural biotechnology. Regardless, agricultural biotechnology remains controversial. Public perception of biotechnology among younger generations of U.S. consumers is split, but the partitions are not entirely clear. This research analyzes the difference in Gen Z perception of biotechnology in relation to: (1) geographic proximity to agricultural production, (2) formal/informal education surrounding the agriculture industry, and (3) primary information sources. To accomplish this, we conducted a brief online survey across several U.S. universities targeting participants with varying agricultural knowledge to analyze the connection between knowledge of agricultural practices and attitudes toward the use of biotechnology. The survey assesses respondents' knowledge of general agriculture, their perceptions of biotechnology and current agricultural practices, and where they receive information regarding these topics (e.g., social media platforms, high school or college classrooms, or personal/professional experience).

**1-21** Factors influencing farmland accessibility and tenure in Tennessee. **Mary Mafuyai\*, Abdelaziz Lawani, Finis Stribling, Arvazena Clardy, Jo Anne Waterman, and Karla Gargus**, *Tennessee State University, Nashville, Tennessee*. In the United States, there were 2.0 million farms in 2021, a significant decline of 6,950 farms from 2020. There were 895.3 million acres in farms with an average size of 445 acres. Approximately 82 percent of all farmlands generated sales of less than \$100,000, while 18.0 percent had sales of \$500,000 or more. Evidence shows that farms continue to get larger in the US.

Young, new, and beginning farmers will face stiff competition over securing land. Poster examines factors affecting farmland access and tenure by young, new, and beginning farmers in Tennessee. Primary data was collected using a questionnaire designed for farmland owners and others interested in accessing farmland in Tennessee. The surveys were administered face-to-face to attendees at farmers outreach in Tennessee. Appropriate statistical models including regression techniques are used to analyze data, present results, and draw conclusions. An Appreciation to USDA/AFRI/NIFA/Small farms program for funding.

## Botany Posters

No poster presentations

## Cell & Molecular Biology Posters

**2-01** Effects of E-liquid aerosol  $\pm$  flavors on the formation of a biofilm/biomass in a multispecies community of oral streptococcal bacteria. **Sarah Sperber\***, **Michael Kalu**, and **Dominic Palazzolo**, *DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Harrogate, Tennessee*. Recently, we reported that 24-hour exposure to flavored E-liquids is detrimental to the growth of individually grown oral streptococci. The aim of this investigation is to monitor the formation and presence of biofilm/biomass of these bacteria as a community after exposure to E-liquid aerosol  $\pm$  flavors. *Streptococcus gordonii*, *Streptococcus intermedius*, *Streptococcus mitis* and *Streptococcus oralis* were grown overnight. The next day, each strain of bacteria was standardized (OD=1.0), combined (1:1:1:1) and seeded in saliva coated plates. Half the plates were exposed to 45-puffs of E-liquid aerosol  $\pm$  flavors (menthol or cinnamon) followed by 24-hour incubation. The remaining plates were incubated for 24-hours followed by exposure to 45-puffs of E-liquid aerosol  $\pm$  flavors. Bacteria were stained with crystal violet and absorbance at 595 nm served as an index of biofilm/biomass. Results suggest that flavored E-liquid aerosols do not effect the formation and presence of biofilm/biomass in a community of oral streptococci.

**2-02** Investigating the role of GSK-3  $\beta$  in glucose homeostasis in the skeletal muscle of mice. **Summer Jackson\***, **Comfort Ogbu**, **Manisha Gupte**, *Austin Peay State University*. Glycogen Synthase Kinase-3 (GSK-3) is a multi-layered serine/threonine kinase that is critical for energy homeostasis under investigation as a potential therapy for patients with type 2 diabetes (T2D). GSK-3 has been shown to be significantly higher in the muscle tissues of T2D patients. GSK-3 inhibitors improve glucose metabolism and insulin sensitivity in rodent models. By using a novel mouse model that allows deletion of the GSK-3 in an isoform-specific and temporal way, we were able to investigate the specific roles of GSK-3 $\alpha$  and GSK-3 $\beta$ . GSK-3 $\alpha$  versus GSK-3 $\beta$  inhibition resulted in a distinct phenotype. GSK-3 $\beta$  inhibition improved glucose clearance in GSK-3 $\beta$  knock-out (KO) mice compared to the wild type (WT) mice..

**2-03** Cellular supplements as a potential therapeutic for riboflavin transporter deficiency. **Lauren E. Pryor\*** and **Felicity Sterling**, *Belmont University, Nashville, Tennessee*. Riboflavin Transporter Deficiency (RTD) is a neurodegenerative disorder that primarily impacts motor neurons. This disease leads to loss of muscle function, which extends to loss of vision, hearing, movement, and ultimately breathing. RTD is an autosomal recessive disease that results from the mutation of related proteins known as riboflavin transporter proteins. These proteins allow for the passage of riboflavin through the cell membrane, where it is used by mitochondria. In disease conditions, cells lack riboflavin transporter proteins. At this time, there are no treatments for RTD. Case studies have shown that cellular support supplements have decreased the severity of RTD symptoms. There have been no cellular studies to support these claims. As such, we have investigated how cells interact with specific cellular supplements in RTD conditions by examining mitochondrial dynamics. Results show that supplementation with vitamin E, coenzyme Q10, and vitamin B2 leads to mitochondrial rescue in disease induced cells.

**2-04** Exploration of the C-terminal domain of topoisomerase II $\alpha$  using mutants. **Daniel Ngabonziza\***, **Jeong Won Chang\***, **Allison G. Jones\***, **Mattalyn R. Hardin\***, **Brooke D. Latham\***, **Addison K. O'Brian\***, **Clark E. Endsley\***, **Joseph E. Deweese**, *Department of Biological, Physical, and Human*

Sciences, Freed-Hardeman University, Henderson, TN 38340 USA (JWC, DN, AGJ, MRH, BDL, AKO, CEE, JED) Department of Biochemistry, Vanderbilt University School of Medicine, Nashville, TN 32340 USA (JED). Topoisomerase II $\alpha$  (TOP2A) is a nuclear enzyme involved in regulating DNA topology during replication, transcription, and mitosis. Cancer drugs can disrupt the activity of TOP2A and block cell growth and division. The C-terminal domain (CTD) is an intrinsically disordered region of ~400 amino acids. While it is the location of the nuclear localization sequences and a histone binding region, the role(s) of the CTD are still poorly understood. Previously, we designed, purified, and examined eleven TOP2A CTD mutants to map regions of influence and function in the CTD. Here we report four additional TOP2A CTD mutants designed based upon biochemical and bioinformatic data. These four mutants included: P1317A; N1462I/R1463L (double-mutant); V1482D; and K1520I. All four mutants are catalytically active. All four also respond to etoposide-induced increase in plasmid DNA cleavage. N1462I/R1463L displays increased plasmid DNA binding affinity (lower K<sub>d</sub>) compared to WT and the other mutants.

**2-05** Descriptive analysis of anthozoan nervous system using fluorescence microscopy. **Leovanna Viamonte and Shanna D. Hanes**, University of Tennessee Southern, Pulaski, Tennessee. The cnidarian nervous system is one of the earliest to evolve in the metazoa. Although the simple nerve net has been visualized in non-symbiotic anemone species, there is very little information on the nervous organization in symbiotic species. In this study, we will utilize fluorescence microscopy to tag neuropeptides and allow visualization of the nervous system in an aposymbiotic anemone model, *Exaiptasia pallida*. Basal metazoan analyses contribute to our understanding of more complex nervous systems in animals, including humans.

## Chemistry Posters

**3-01** Solvent Effects on Structure of Spin-coated Ge<sub>20</sub>Sb<sub>5</sub>S<sub>75</sub> Glasses. **Bailey Shedden\***, **Carrie Brennan**, **Jiri Jancalek**, **Michal Kurka**, **Stanislav Slang**, and **Miroslav Vicek**, Austin Peay State University, Clarksville, Tennessee (BS, CB), and University of Pardubice, Pardubice, Czech Republic (JJ, MK, SS, MV). The use of solution-based techniques to produce chalcogenide films for optical applications has become more common due to their low cost and reproducibility. Spin-coating allows production of thin films with distinct optical properties and chemical compositions. The goal of the present research is to investigate the impact of solvent composition on spin-coated Ge<sub>20</sub>Sb<sub>5</sub>S<sub>75</sub> films. A series of glasses were deposited using the solvent systems: pure n-butylamine, 10% of methanol in n-butylamine, 10% toluene in n-butylamine, 10% chloroform in n-butylamine, and then structurally characterized using Raman spectroscopy, UV-VIS-NIR spectroscopy, AFM, and SEM/EDS. Structural changes due to solvent modification were then compared. It was found that methanol had a positive effect when structured with electron beam lithography in comparison to pure n-butylamine and toluene solutions, while chloroform in n-butylamine had a negative effect. Solvent systems of pure n-butylamine, methanol, and chloroform performed similarly when hot embossed, and the toluene system did not produce a structure.

**3-02** Synthesis and Physicochemical Properties of a Trifluoroacetamido Derivative of Acetaminophen. **Joshua A. Boldon\***, **Thomas A. Shell**, Lincoln Memorial University, Harrogate, Tennessee. Acetaminophen (N-acetyl-para-aminophenol, APAP) is a commonly used analgesic that is safe when taken at therapeutic doses. However, overdose quantities of APAP cause severe liver damage. This is a result of Cytochrome P-450 (CYP) enzyme catalyzed conversion of APAP to N-acetyl-p-benzoquinone-imine (NAPQI), a toxic metabolite. NAPQI reacts with the thiol side chain of glutathione. Therefore, high concentrations of NAPQI deplete the cells of glutathione, which results in cell death. A trifluoroacetamido derivative of acetaminophen (3F-APAP) was synthesized and the physicochemical properties of the molecule were compared to those of APAP. Relative to APAP, 3F-APAP is five times more lipophilic based on measured octanol-water partition coefficients for the molecules indicating that 3F-APAP likely has better bioavailability. More importantly, 3F-APAP is oxidized at half the rate as APAP by the CYP proteome of Sprague-Dawley rat liver microsomes. Based on the decreased rate of CYP catalysis 3F-APAP is potentially less toxic than APAP.

**3-03** Progress towards the Synthesis of Unsymmetric Tridentate Complexants for Application to Minor Actinide Separations. **Bolade R. Ajibola\* and Jesse D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. Nuclear energy is distinguished for the generation of emissions-free power which is non-polluting to the atmosphere. Despite this pros of nuclear energy, the highly radioactive waste generated from spent nuclear fuel (SNF) as a result of the minor actinides (MA) being present needs to be effectively managed. The formation of an ideal complexant that will selectively separate MA from SNF is essential. Developing unsymmetric complexant scaffolds can be very explorative and has been hypothesized to improve challenges such as solubility difficulties and degradation challenges that have marginalized the efficiency of some symmetric complexants. With soft-Lewis basic unsymmetric complexants, substituents with different electronic properties can be introduced on both sides of the complexant which can aid the performance in separating MA from SNF. The synthesis of 1,2,4-monotriazinylpyridyl-1,2,4-triazole (MTP triazole) is currently in progress. Current synthetic results and future directions will be presented.

**3-04** Progress Towards the Convergent Synthesis of Unsymmetric, Pyridyl Imid- and Oxazoles via Cyclization of Amidines and Amides. **Christopher Hudak and Jesse D. Carrick**, *Tennessee Technological University*. Nuclear power is an attractive option for a reliable source of clean energy that could satisfy future energy needs. However, spent nuclear fuel (SNF) contains several highly radio toxic nuclides that pose a hurdle for the recycling of SNF. Soft-Lewis basic heterocycles such as the bis-1,2,4-triazinyl pyridine complex have been proven to be able to selectively extract minor actinides from minor lanthanides in SNF. The development of these compounds has been focused on the synthesis of symmetric compounds. However, these scaffolds have drawbacks such as solubility and difficulties stripping the ligand and the metal after the separation. The goal of this work is to develop unsymmetric imid- and oxazole scaffolds to be used in the separation of minor actinides and lanthanides in spent nuclear fuel. Current work is focused on method development and optimization.

**3-05** Negative Ion Photoelectron Spectra of Cyclobutadiene and Cyanocyclobutadiene: Accessing Ground Singlet and the Lowest Triplet States from Below. **Jonathan A. Dupuy, Wilson K. Gichuhi**, *Tennessee Technological University, Cookeville, Tennessee*. In this work, the negative ion photoelectron spectra of cyclobutadiene (CBD) and cyanocyclobutadiene (CCBD), acquired through the computation of Franck Condon (FC) factors, are presented. The FC calculations are based on a harmonic oscillator model that utilizes the density functional theory (DFT) outputs at the uB3LYP/aug-cc-pVQZ level. Although the Hückel molecular orbital theory (HMO) predicts the ground state of CBD to be a triplet state, our calculations show that in both CBD and CCBD, the ground states are valence bound singlets (S0) with respective adiabatic binding energies of 0.166 eV and 1.502 eV. The lowest lying triplet states (T1) are located 0.218 eV and 0.148 eV above the S0. The photodetachment results presented here are consistent with cation photoelectron spectroscopy studies that predict a rectangular S0 structure that is a result of pseudo (or second order) Jahn-Teller effect. The S0 and T1 vibrational structures are presented and discussed.

**3-06** Characterization of Biogas Production by Anaerobic Digestion of Food Waste Using FTIR & GC-MS Analysis. **Tanmoy Acharjee\*, Chance Perkins\*, Mina Mohebbi, Ngee-Sing Chong**, *Middle Tennessee State University*. Anaerobic digestion of food waste is investigated for its potential to reduce direct emission of greenhouse gases. The gas phase emissions of anaerobic digestion were analyzed at different time intervals over 25 days. The food waste was kept in an airtight bottle with a cap having a tubing connected to a 1-liter Tedlar bag for collection of gas samples. Both the temperature and pH of the digester were continuously monitored throughout the digestion period. Infrared spectrometry with a 10-meter gas cell was capable of measuring carbon dioxide, ethanol, and methane at 1-1000 ppm levels. However, gas chromatography coupled to mass spectrometry with cryogenic sample preconcentration at -160 °C was necessary for analysis of volatile organic compounds including the malodorous sulfur compounds at the concentration range of 1-1000 ppb. The food waste was also screened for the presence of microplastic particles using Raman and scanning electron microscopy with energy-dispersive X-ray microanalysis.

**3-07** Comparison of Thermally Induced Desorption/decomposition and Combustion of Tire Rubber Materials. **Kevin Sanders\*, Amrutha Pogadapula\*, Sean Willis\*, and Ngee Sing Chong**, *Middle*

Tennessee State University, Murfreesboro, Tennessee. Waste tires have been recycled as tire-derived fuel (TDF) for industrial facilities, tire-derived aggregates used in lightweight embankment fill, road repair, subgrade road insulation, rubber mulch as playground groundcover material, crumb rubber as the surface material for athletic tracks and fields, rubber mats, asphalt and rubber powder with secondary uses from injection molding products, coatings, roofing materials and asphalt applications. Gas chromatography coupled to mass spectrometry (GC-MS) is used to study the desorption of volatile organic compounds (VOCs) at the temperature ranges of 40-50 °C and 200-350 °C because the recycled products mentioned above are exposed to heat during hot summer weather and in equatorial countries and manufacturing conditions including the injection molding process. Combustion analysis of TDF will be evaluated with both infrared spectrometry and GC-MS with cryogenic preconcentration of VOCs. This study provides data pertaining to environmental health and possible toxicant exposure of VOCs from recycled tire products.

**3-08** Expression and Purification of the JNK-3 Mutant Without the N Terminus. **Zachary Rush\***, **Kirsten Spradlin\***, **Zachary Knellinger\***, **Xuanxhi Zhan**, Tennessee Technological University, Cookeville Tennessee. c-Jun N-terminal Kinases (JNKs) are a family of mitogen activated protein kinases (MAPK) which regulate many stress related responses in cells including: apoptosis, cell proliferation, and cell differentiation. There are three JNK subfamilies including two ubiquitous expressed JNK1 and 2, and neuron-specific JNK3. JNK3 contains an extension on the N-terminus, named NJ38 in this investigation. Its impact on the kinetics of the molecule are yet to be determined. To deepen the understanding of the mechanism and kinetics of NJ38 terminus, we designed and constructed a mutated form of JNK3 that has NJ38 removed to investigate the efficacy of JNK3 without it, referred to as J3DN (JNK-3 deleted NJ38). To unravel the kinetics of J3DN, the protein must be expressed and purified. Here, we report our efforts to express and purify this J3dN mutant. We have optimized the expressing temperature, time-line and IPTG concentration in small scale and purified this JNK3 mutant protein by Ni-NTA chromatography.

**3-09** GC-MS Analysis of Natural Rock Accretions Covering Ancient Rock Art. **Hoang Luu\***, **Jhansi Yadlapati\***, **Huyen Nguyen\***, **Saloni Naidu\***, **Liam McDade\***, **Bonnie Kennedy\***, **Ayumi Bonev\***, and **Jon Russ**, Rhodes College, Memphis, Tennessee. Ancient rock paintings (pictographs) are found globally, usually inside dry rock shelters and under rock overhangs. Rock surfaces in environments protected from rain and runoff are generally covered with a natural accretion composed mainly of calcium oxalate (CaC<sub>2</sub>O<sub>4</sub>). These accretions cover or encapsulate the ancient paints, fixing the pigments to the rock substrate and protecting them from surface erosion; thus, the oxalate accretions preserve the artifacts. Additionally, radiocarbon dates of oxalate accretions can provide estimates on the age of pictographs, as well as evidence of past climate changes. However, there is a significant gap in our understanding of how oxalate accretions form. Here we report on the trace organic composition of oxalate-rich accretions from sites in Texas, Australia, Spain and Patagonia using gas chromatography-mass spectrometry (GC-MS). The results suggest that the source of the oxalate is reactions between calcium on the rock surfaces with oxalic acid dissolved atmospheric aerosols.

**3-10** Toxicity of Antimicrobial Peptide Analogs from Fish *p. Punctata* Venom. **Chinmayi Alli\***, **Darsani Patel**, **Roberto de la Salud Bea**, Rhodes College, Memphis, Tennessee. The venom of *Pogonoperca punctate*, also known as "soap fish" contains short peptides with antimicrobial properties. One of these is Grammistin Pp2a, a 13 amino acids peptide with a reported broad spectrum of antimicrobial activity. In our group we have designed and synthesized a library of 14 analogs, including the original, of the peptide Pp2a. This design includes modifications on specific positions of the amino acid sequences and, for a second library of peptides, the addition of a fatty acid chain (Myristic acid) on each peptide to increase hydrophobicity and expected increase in antimicrobial activity. In this work, we will present the first results of this project, which includes the synthesis of all the analogs and the toxicity results against human red blood cells.

**3-11** Investigation of the Photosynthetic Capabilities of Co(EtPyPDI). **Nicholas Suffern\*** and **Will Eckenhoff**, Rhodes College, Memphis, Tennessee. As the global population grows, the need for renewable energy grows with it. One source of energy that seems promising is artificial photosynthesis to produce hydrogen gas. The PDI ligand seems to be useful for light-driven hydrogen production because of the pKa and hemi-lability of the pendant base. Research has been done using a Ni(EtPyPDI) complex,



and those results showed promise, but looked like they could be improved upon. Using the Co(EtPyPDI) complex, in a solution of Ru(bpy)<sub>3</sub><sup>2+</sup> and ascorbic acid, generated turnover numbers of up to 1700 during light-driven hydrogen production.

**3-12** Investigation of Ni(MePyPDI)<sub>2</sub> as a Catalyst for Hydrogen Production. **Joshua D. Seider\* and William Eckenhoff**, Rhodes College, Memphis, Tennessee. With increasing global population, the need for avant-garde sources of energy continues to advance. An alternative source of energy can be found via the implementation of artificial photosynthesis to produce hydrogen gas. Therefore, the development of more active and robust catalysts is necessary in order to make artificial photosynthesis a viable method of hydrogen generation. Studies have shown that metal complexes with redox non-innocent ligands and pendant base groups are highly active for proton reduction. Ni(EtPyPDI)<sub>2</sub> has shown to be a promising catalyst by producing hydrogen gas using Ru(bpy)<sub>3</sub><sup>2+</sup> and ascorbic acid generating turnover numbers of 1400. In this project, the EtPyPDI was replaced with MePyPDI to synthesize Ni(MePyPDI)<sub>2</sub>. The smaller methyl group should lead to increased compound stability and will be used to test our hypothesis that dissociation of the pyridyl group is key to catalytic activity. The synthesis of Ni(MePyPDI)<sub>2</sub> and its catalytic activity compared to Ni(EtPyPDI)<sub>2</sub> will be discussed.

## Ecology & Environmental Science Posters

**4-01** Ambrosia beetle attacks and colonization on field nursery tree species under flood and drought stress. **Madhav Parajuli\*, Cansu Oksel, Krishna Neupane, Christopher M. Ranger, and Fulya Baysal-Gurel**, Tennessee State University, McMinnville, Tennessee (MP, CO, KN, FBG), and USDA-Agricultural Research Service, Horticultural Insects Research Lab, Wooster, Ohio (CMR). The objective of this study was to explore ambrosia beetle preference for tree species varying in their tolerance of water stress. Dogwood (flood and drought intolerant), red maple (flood tolerant and drought intolerant), and redbud (flood intolerant, drought tolerant) were assigned to flood, drought, and sufficient water for 28 days. Two trials were conducted in May and June 2023. Ambrosia beetle attacks were counted every other day for 28 days and the number of galleries formation were recorded. Under flood stress, the ambrosia beetle attacks were higher in dogwood compared to redbud and there was no attack in red maple. Of the total attacks under flooding, galleries formation was higher in dogwood than in redbud. Tree species assigned to drought and sufficient had no beetle attacks. This study suggested that nursery tree species intolerant of flooding is more prone to attack by ambrosia beetles.

**4-02** Combining molecular analyses with morphology to identify zoantharians located at Toco, Trinidad, southernmost region of the Caribbean Sea. **Rebecka Roddy\* and Stanton G. Belford**, University of Tennessee Southern, Pulaski, Tennessee. Annual coral reef surveys record cnidarian and invertebrate abundance off the northeastern coast of Toco, Trinidad. However, some species are difficult to accurately identify due to morphological similarities. One such cnidarian species are zoantharians, therefore molecular and phylogenetic analyses in this study gained a more comprehensive understanding of zoantharian diversity. The line intercept transect method collected benthic abundance data. Species morphology and molecular analyses were used for species identification. Benthic surveys at 3 sites: Salybia Bay (SB), Pequelle Bay (PB), and Grande L'Anse (GLA) recorded zoantharian mean cover as 32%, 70%, and 51% respectively, with *Palythoa* and *Zoanthus* spp. being most widely distributed. Mitochondrial cytochrome oxidase subunit I (mt COI) and 16S rDNA identified specimens as *Z. pulchellus*, *Z. sociatus*, *P. caribaeorum* and *P. grandiflora*. The 16S rDNA marker also added *Z. aff. pulchellus* for the first time. Future molecular analyses will continue to add knowledge on the species biodiversity.

**4-03** Does human activity impact provisioning and nesting success of Osprey at Reelfoot Lake? **Sylar M. Lowery\* and H. Dawn Wilkins**, University of Tennessee at Martin, Martin, Tennessee. Reelfoot Lake is a natural, shallow lake with a healthy population of fish desired by humans and Osprey (*Pandion haliaetus*). Many people visit the lake to fish, duck hunt, and observe wildlife. Our goal was to determine if human activity impacts provisioning and nesting success of Osprey. We compared twelve Osprey nests located in Middle Basin, and twelve nests in Upper Blue Basin. More boats per hour were observed in the Middle

Basin, however, their speed and distance from nest were similar between basins. Thirty percent of nests in Middle Basin successfully fledged young, while 50% of nests in Upper Blue Basin were successful. There was no difference in the mean number of young fledged per nest or mean number of fish brought per hour between basins. Since human presence may impact nesting success, we recommend staying a respectful distance from the nests during the breeding season.

**4-04** Utilizing presence only prediction software to model *Morchella diminutiva* occurrence. **Spencer Baldwin\***, **Barbara Shock**, and **Whitney Kistler**, *Lincoln Memorial University, Harrogate, Tennessee*. Morels (*Morchella spp.*) are recognized for their cultural importance and culinary use; however, some species remain understudied. *Morchella diminutiva* was formally described in 2012, but little follow up research has occurred. To determine the ecology of *M. diminutiva*, in situ experiments should be conducted. I am developing a predictive species distribution model of *M. diminutiva* to guide future environmental collections and research. MaxEnt, a geospatial analysis program, uses known observations to identify which environmental factor(s) best predict *M. diminutiva* occurrence. I created a MaxEnt model of the United States with over 25 variables. I hope to determine the strongest predictor(s) of *M. diminutiva* presence. In 2024, I will conduct sampling efforts at predicted locations to test the predictive accuracy of the model using eDNA methods. The model and these data will add to the understanding of *M. diminutiva*, an under-studied morel.

**4-05** Predicting crown volume for individual conifer trees using airborne laser scanning. **Nirmal Thapa\*** and **Bharat Pokharel**, *Tennessee State University, Nashville, Tennessee*. An accurate estimate of a tree's crown volume is essential as it is highly correlated to tree biomass, volume, and carbon stocks. With the availability of high-density 3D imagery, we hypothesized that there is a possibility of developing routines to estimate crown volume of an individual tree. In this project, we have evaluated concave hull method to calculate the crown slice area of individual conifer trees from the airborne laser scanning (ALS) data and an adaptive slicing method which considers the rate of change in area with tree height. We aimed to evaluate the prediction accuracy of the tree crown volume with field-based measurement from the temporary field inventory plots. Once the tree crown volume is estimated accurately, then it can be used to input as a predictor variable for total tree volumes or biomass and carbon stocks, which then can be estimated for all trees across the study area.

**4-06** Construction of biomass gasifier and testing of real-world emergencies. **Trevor J. Holt**, *Lincoln Memorial University, Harrogate, Tennessee*. My project is a working gasifier model for the purpose of testing different materials that could be used to fuel a generator in case of natural disasters. A wood gasifier is a device that can break down any organic matter through gasification into the basic elements carbon monoxide, hydrogen, and methane. The system partially burns the fuel source in an oxygen deprived environment that results in the release of volatile gases that can power an engine or be burned in a similar manner to propane. My project is still in the data collecting stage but has been able to produce flammable gas from wood pellets like you would use in a wood pellet stove. Eventually other materials such as building materials found after a natural disaster will be tested. The information collected in this study will be useful in determining the effectiveness of this system in an emergency.

**4-07** Prevalence of the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) in freshwater ecosystems throughout Harlan County, Kentucky. **Logan J. Taylor\***, **Whitney Kistler**, **Barbara Shock**, and **Madison Hall\***, *Lincoln Memorial University*. The eastern hellbender (*Cryptobranchus alleganiensis*) is an aquatic giant salamander species endemic to the United States. Eastern hellbenders are considered a sentinel species because they have permeable skin and are sensitive to changes in water quality. This study utilized eDNA methods to determine if the eastern hellbender is present in Harlan County, Kentucky. Harlan had a historical population of hellbenders. We used a pump-powered system to filter 1L of water and collect eDNA onto filter paper. We took samples from 3 Cumberland River tributaries: the Martins Fork River, Clover Fork River, the Poor Fork River, and used tap water and spring water for the controls. We then extracted eDNA from filter papers and conducted a species-specific PCR to determine the presence of hellbender DNA in the water. We are still processing samples and the results are not complete yet.

**4-08** Quality and quantity of public school green spaces in Nashville, Tennessee: The more green the more green spaces. **Griffin Andrews\***, **Anna Lennon\***, and **Darlene Panvini**, *Belmont University*,

*Nashville, Tennessee.* Greenspaces on and near school property have been correlated to student mental health and academic achievement. However, there is a gap in the literature investigating how quality and quantity of green space is related to socioeconomic status and school economic metrics in public high schools and the surrounding neighborhoods. Nashville public high schools located in higher socioeconomic areas and having greater financial resources were predicted to provide larger, higher quality green spaces. This study combined a quantitative analysis of neighborhood socioeconomic metrics, school socioeconomic metrics, and quantity of green space (assessed using iTree Canopy) with a qualitative field assessment using the Neighborhood Green Space Tool. Preliminary analysis reveals a positive correlation between green space quality and quantity with higher socioeconomic factors. This suggests that students from higher socioeconomic-associated schools and neighborhoods could have an academic advantage, highlighting the need for equity in green spaces.

**4-09** Relationship between tree canopy cover, impervious surfaces, and bird biodiversity in urban parks in Nashville, Tennessee. **Lydia Mitchell\* and Darlene Panvini**, Belmont University, Nashville, Tennessee. Bird diversity is an indicator of the overall biodiversity in urban green spaces. Identifying factors associated with urban green spaces that strongly influence bird biodiversity can inform the development and management of urban green spaces. Parks with larger areas of impervious surfaces were predicted to have lower bird diversity than those with more tree canopy coverage. This study used iTree Canopy to determine the percentage of tree canopy and impermeable surfaces for four different urban parks in Nashville, Tennessee. Two parks were closer to the urban core and two were farther away. Tree canopy and impermeable surface cover were compared to biodiversity of bird species determined from acoustic song meter recordings within the parks. Preliminary analysis of the data suggests that parks with higher percentages of impermeable areas relative to tree canopy had lower overall bird biodiversity. Managing parks for more tree canopy coverage can enhance urban bird diversity.

**4-10** Species richness of moths in parks surrounded by varying levels of urbanization around Nashville, Tennessee. **Allie Bennett\* and Darlene Panvini**, Belmont University, Nashville, Tennessee. Moths can act as indicators of environmental wellness due to their pollution sensitivity and the complexity of biodiversity required to support their life cycles. Urbanization can impact the occurrence of moths in protected green spaces. Higher moth species richness was hypothesized to occur in parks surrounded by more rural areas. Three metropolitan parks were chosen in the Nashville area: downtown, within a suburban neighborhood, and in a rural area. Tree canopy cover and degree of impervious surfaces were assessed for each park and surrounding area using iTree Canopy. Moths were attracted to a white sheet using a mercury vapor bulb, UV wand, and sugar mix. Individuals were identified to species. Preliminary analyses indicate higher moth species richness in the park surrounded by rural landscape. Supporting moth diversity in urban areas may include monitoring for pollution and installing a biodiverse mix of plant species in areas surrounding public green spaces.

**4-11** Development of a checklist to assess university campuses for bird-friendliness qualities. **Tina Al-Hemoud\*, Chaze Espeleta\*, and Darlene Panvini**, Belmont University, Nashville, Tennessee. Nashville, Tennessee recently became part of the U.S. Fish and Wildlife Service's Urban Bird Treaty (UBT) program. The Nashville UBT aims to protect and enhance bird-friendly habitats, reduce hazards to birds, and connect people to nature through bird-related activities. To support these aims, students in a conservation biology course researched potential hazards and ideal habitats for birds on college campuses. They developed a checklist covering various bird-friendly criteria, including landscaping, water sources, windows, lighting, use of pesticides, and presence of cats and other bird predators. Students beta-tested the checklist on the campus at Belmont University. The goals of this project are to engage students in learning about urban bird-friendly criteria, apply that information to develop and test the checklist, and create a tool that can be used by other universities to assess their campuses for characteristics that support urban birds. The checklist and course project details will be presented.

**4-12** Evaluating biodegradation of microsystem in wetland sediments, Tennessee State University Wetland, Nashville, Tennessee. **Aaliyah Cotton, De'Etra Young, and Tom Byl**, Tennessee State University, Nashville, Tennessee (AC, DY, TB), U.S. Geological Survey, Nashville, Tennessee (TB). Beavers established a series of wetland ponds on Tennessee State University's main campus in Nashville, Tennessee beginning in 1996. This wetland system has experienced eutrophication and

harmful algal blooms. Recalcitrant microcystin toxin sorbs to algae and detritus and settles to the bottom, remaining there for decades. We are evaluating the use of a *Bacillus* bacteria treatment to bioremediate microcystin toxins. Three 28-cm sediment cores were collected from treated and untreated locations and cut into 4-cm sections and analyzed to determine if algal toxins were concentrated at different levels. Preliminary results demonstrate that the top sediment horizons held higher toxin concentrations, indicating there has been an increase in HABs in recent years. There was approximately twice as much toxin in the top 10-cm of untreated sediments compared to treated. The *Bacillus* treatment appears to reduce the concentration of microcystin in the sediments.

**4-13** Evaluation of a qPCR protocol to detect red-ear slider using eDNA. **Bailey Gilbert\* and Caleb Kersey**, *Freed-Hardeman University, Henderson, Tennessee*. A growing area of ecology includes the implementation of environmental DNA (eDNA) to survey and monitor populations from diverse environmental settings. Species specific primers were used to detect and quantify the red-ear slider (*Trachemys scripta elegans*) using eDNA collected from a pond on the campus of Freed-Hardeman University. This poster will provide an overview of qPCR data generated from eDNA, specifically using SYBR Green dye quantification, including an analysis of the troubleshooting process involved in the establishment of this protocol.

**4-14** Environmentally-conscious and cost-effective isolation of soil microplastics. **Katie Bessel\*, Molly Gidney, and Julie Baker Phillips**, *Cumberland University, Lebanon, Tennessee*. Microplastic pollution is a continuously growing concern and researching the impacts of microplastic contamination require methods of quantification. Our current focus is developing a standard operating procedure to separate microplastics from soil using an accessible, environmentally-conscious, and cost-effective method. Density separation with sieved soil, oil, and a salt solution result in distinct separation of microplastics. Microplastics can then be isolated from the oil and organic material through vacuum filtration and a hydrogen peroxide digestion step. To visualize and quantify the microplastic contaminants, Nile Red is used to fluoresce the microplastics under a modified basic microscope. Developing a cost-effective protocol with minimal specialized equipment is essential for monitoring microplastics to determine varying extents of contamination with the potential to understand the impacts of microplastics on microorganisms.

## Engineering & Engineering Technology Posters

**5-01** Strengthening the foundation: Material testing for 1/4 scale pulling tractor frame optimization. **Nathan Robison\*, Sandy Mehlhorn, Ray Witmer, and Jared Teague**, *University of Tennessee at Martin, Martin, Tennessee*. Student teams allow transfer of classroom learning to real-world skills. One such team at UT Martin has students design and fabricate a quarter scale pulling tractor. Understanding the stresses that will be applied to the frame and determining materials to manage stresses produced by these loads are an essential step in the process. For this project, several potential frame materials were subjected to tensile, compression, and bending tests in the lab. These tests were compared with factors such as weight and cost to determine the best frame material. The results indicated the most suitable material was 3/4" OD schedule 40 steel tubing. Although its tensile strength was lower than other materials tested, it was sufficient for the application and the weight allowed a significant reduction of total weight over previous designs.

## Geology & Geography Posters

**6-01** Online science education: Examples from pre and post covid. **Lan Depriest, Adam Wilson, and Joey Mehlhorn**, *University of Tennessee at Martin, Martin, TN*. To state that the Covid era forever changed the face of education is an understatement, but never was this more dramatic than in the world of online education. For years, many disciplines insisted that the online paradigm simply would not work for their subject matter due to the hands-on nature, and there was limited pressure to attempt online

instruction in these areas. This was very pronounced in the sciences, especially classes that required a laboratory component. As result of Covid shutdowns, universities learned by necessity to create and deliver science-based coursework in an online format and the results created more discussions about what can be accomplished online. This project reviews online delivery options pre and post Covid with a focus on delivering online laboratory experiences at a regional public university. Best practices are discussed along with faculty and student support requirements needed for student success.

## Health & Medical Sciences Posters

**7-01** Effects of popular flavored E-liquids on glutathione levels of oral epithelial cells: A comparison of HPLC- fluorescence and HPLC- UV methodologies. **Siara Minton, Giancarlo Cuadra, and Dominic Palazzolo**, Lincoln Memorial University, Harrogate, Tennessee (SM, DP) and Muhlenberg College, Allentown, Pennsylvania (GC). This study compares methodologies used to determine intracellular glutathione levels from OKF6/TERT-2 oral epithelial cells. In a previous study, using HPLC with UV detection, exposure of OKF6/TERT-2 cells to cinnamon flavored E-liquid increased oxidative stress as indexed by an increased ratio of oxidized glutathione (GSSG) to reduced glutathione (GSH). The problem with HPLC-UV is that glutathione chromatograms display longer retention times, crowding with unknown peaks, and low glutathione resolution. Consequently, the study was repeated using HPLC with fluorometric detection. The results obtained using HPLC-fluorescence yield cleaner glutathione chromatograms with shorter retention times, no crowding and better glutathione resolution. Furthermore, the glutathione results using HPLC- fluorescence reliably confirm the previous results using HPLC-UV. In other words, cinnamon flavored E-liquids induces oxidative stress in OKF6/TERT-2 cells. In conclusion, the use of HPLC- fluorescence produces cleaner and more reliable glutathione chromatograms than HPLC-UV.

**7-02** Effects of electronic cigarette-generated aerosol  $\pm$  flavors on the growth of *Porphyromonas gingivalis*. **William Huff\*, Creighton Adams, Anthony Campbell, Makenzie Muley, Mariam Shakir, and Dominic Palazzolo**, DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Knoxville, Tennessee. A balance of commensal and pathogenic bacteria in the oral cavity is required for good oral health. Studies indicate that E-liquids are detrimental to several strains of oral commensal streptococcal bacteria. However, little information is available regarding the effects of E-liquids on oral pathogenic bacteria. For this reason, the anaerobe, *P. gingivalis*, was chosen with the aim of determining the effects of E-liquid aerosols on its growth. Colonies of *P. gingivalis*, initially grown anaerobically on agar, were transferred to a growth media for planktonic growth. At the start of growth, bacteria were exposed to 0, 15, 30 or 45 puffs of E-liquid aerosol  $\pm$  flavors according to CORESTA guidelines and subsequently incubated anaerobically for 0, 6, 18, 24 and 30 hrs. *P. gingivalis* growth was monitored by optical density of the growth media and results suggest that E-liquid aerosol  $\pm$  flavors hinder growth in a puff-dependent manner.

**7-03** The impact of an expanded environmental enrichment intervention on subsequent opioid preference in opioid-abstinent C57BL/6J mice. **Rob Sullivan\*, Cadence Bronson\*, Nana Addo Offei\*, and Kate Cammack**, The University of the South, Sewanee, Tennessee. Opioid use disorder (OUD) is extremely common, and it is critical to identify easy, cost-effective interventions that reduce opioid relapse and support abstinence. Exercise- or enrichment-based interventions show potential in clinical and preclinical models. In this study, female mice self-administered escalating concentrations (0.1-0.6mg/ml) of oxycodone via a 2-bottle choice protocol for two weeks. After discontinuing oxycodone, experimental mice were housed with environmental enrichment and regular exposure to a novel voluntary exercise arena; control mice remained in standard housing. After 10 days, conditioned place preference (CPP) for oxycodone (2mg/kg i.p.) was assessed in a relapse-like procedure; experimental and control mice showed similar oxycodone preference ( $p>0.05$ ). The study was repeated with voluntary oxycodone consumption rather than CPP, with similar results. These results will be evaluated in the context of existing literature, potential mechanisms, and sex bias in biomedical research using preclinical models.

**7-04** Rapid detection of pathogenic *Escherichia coli* based on CRISPR technology. **Pallavi Rathore\***, **Agnes Kilonzo-Nthenge**, **Korsi Dumenyo**, **Zeinab Yadegari** and **Ali Taheri**, *Tennessee State University, Nashville, Tennessee*. Access to safe, nutritious food is crucial for good health, but foodborne pathogens, such as pathogenic *Escherichia coli*, present significant risks. Traditional detection methods involve time-consuming culturing and biochemical tests, and PCR-based techniques often require specialized resources and expertise. Our project introduces an efficient detection method utilizing CRISPR-Cas12a sensing. This approach enables the rapid, sensitive, and specific detection of pathogenic *Escherichia coli*. The detection process combines PCR-amplified gene regions associated with pathogenicity, a reporter probe, Cas12a enzyme, and gene-specific crRNA targeting key pathogenic genes (stx1, stx2, and hlyA). When exposed to UV light, the presence of pathogenic bacteria triggers a fluorescent response in the CRISPR reaction. This precise, cost-effective, and user-friendly technique overcomes current limitations and holds promise as a versatile method for rapid responses to diseases that jeopardize human health and large-scale biosecurity in plant and animal production.

**7-05** Antibacterial properties of soursop and the greater implications to non-traditional medicine. **Trinity Mobley\*** and **Amy L. Thompson**, *Austin Peay State University, Clarksville, Tennessee*. Soursop is a plant found in tropical environments around the world and is widely used in Central America and the Caribbean in cooking and also for its purported medicinal properties. This plant has been suggested to have anticancer, antidiabetic, and antimicrobial properties, among others, although studies have been conflicting or negative in support of these claims. In the current study, we examined the antibacterial properties of soursop oil against a variety of bacterial strains using disc diffusion assays. Our hypothesis was that soursop would be effective against some strains of bacteria, but would not have the widespread benefits it is suggested to have. Results from our study support our hypothesis that soursop does not have anti-microbial properties for many common bacterial strains. Although there may be some benefits of using soursop, our results do not support using it as an antibacterial agent.

**7-06** Evaluating hemolysis zones of plant oils with different bacterial strains. **Vanessa J. Mendez** and **Amy L. Thompson**, *Austin Peay State University, Clarksville, Tennessee*. Plant oils have been used for numerous applications including in cleaning products, for aromatherapy, and as healing agents. Several studies have examined the antibacterial properties of these oils. In our lab, we noticed that when we used certain oils in disc diffusion assays, there was sometimes hemolysis of the blood agar, even in the absence of bacterial growth. In the current study, we sought to determine what oils caused hemolysis and the influence of bacteria type. We hypothesized that there was an interplay between certain plant oils and certain strains of bacteria leading to hemolysis. Our results showed that some plant oils alone had the ability to hemolyze blood and that the appearance of the hemolysis zone sometimes changed depending on the bacteria type. There does seem to be an interplay between oil and bacteria in some cases, but more work needs to be done to determine what is occurring.

**7-07** Potential antimicrobial properties of ginger oil in preventing bacteria growth. **Catherine M. Conn\*** and **Amy L. Thompson**, *Austin Peay State University, Clarksville, Tennessee*. With the rise of antibiotic resistance, interest in alternative treatments to bacterial infections has increased. Ginger has been cultivated for use in food and in medicine for many years. It is used to treat a variety of ailments like diabetes, arthritis, nausea, and fever, although not all of these uses are supported by scientific evidence of efficacy. Ginger root extract has exhibited antimicrobial effects on bacteria including *Staphylococcus aureus*, *Bacillus subtilis*, and *Escherichia coli*. While antimicrobial properties of ginger root extract have been identified, potential antimicrobial effects of ginger oil are not yet clear. For this study, an analysis of ginger oil on common bacteria strains was conducted using a disk diffusion assay. We hypothesized that ginger oil would be effective in preventing growth of common strains of bacteria. Our research showed that ginger oil has little effect on most strains of bacteria tested. Future work will examine additional strains.

**7-08** The effect of orange oil in preventing bacterial growth. **Charles S. Welch\*** and **Amy L. Thompson**, *Austin Peay State University, Clarksville, Tennessee*. For centuries, plants have been utilized for their medicinal properties and many people still look to more natural remedies to treat common ailments. Plant oils have gained popularity for their soothing capabilities and other benefits, although less is known about their potential antimicrobial benefits. Some studies show that lemon oil can prevent bacterial growth and

the antimicrobial effect of lemon juice is well established. The properties of other citrus plants, like orange, are not as well researched. In the current study, we used orange oil in disc diffusion assays to determine its effectiveness in preventing the growth of common bacterial strains. We hypothesized that orange oil would have antimicrobial properties, similar to what is observed with lemon oil. Unlike lemon oil, however, orange oil showed no evidence of antimicrobial activity. Future studies will include more strains of bacteria to determine if there is any difference across strains.

**7-09** Using various plant oils as an antibacterial agent to reduce the growth of *Streptococcus equi* to prevent cases of strangles in equine. **Alexandra Baum\* and Amy L. Thompson**, *Austin Peay State University, Clarksville, Tennessee*. The bacteria, *Streptococcus equi*, causes a contagious equine disease known as strangles. When inhaled or ingested, *Streptococcus equi* can infect the upper respiratory tract of horses, leading to lymphadenopathy. The purpose of this study was to identify plant oils that have antimicrobial properties against *Streptococcus equi*. Plant oils have been used with horses as calming agents, insect repellent, and antimicrobial agents. Our hope is that certain oils can be used to control *Streptococcus equi* on common items used in the horse's environment to reduce the potential for *Streptococcus equi* exposure. We hypothesized that some plant oils would be effective at preventing *Streptococcus equi* growth. Of the oils screened, cinnamon, clove, and lemongrass showed anti-bacterial properties in disc diffusion assays, supporting our hypothesis. The next step is to grow *Streptococcus equi* on materials used in a barn setting and use oils to determine how well the bacteria growth is controlled.

**7-10** Type II diabetes: Knowledge & behavior risk assessment of college students. **Sarah Bertram\* and Pamela Hobbs**, *Lee University, Cleveland, and Tennessee*. Just over half a billion people are living with diabetes globally, 90-95% of which are type II diabetes (T2D). The onset of diabetes at a younger age is associated with longer exposure to the disease leading to increased complications. Lifestyle modifications like physical activity and improved nutrition have been shown to be the most effective prevention. College-aged students develop lifelong practices at this age, yet little is known about their knowledge of T2D. An anonymous survey was distributed through social media for college students to share their physical and nutritional habits. Survey results demonstrated a high level of knowledge of diabetes. However, college students did not understand the correlation of diabetes with individual health habits. This research has implications for developing health promotion programs for college students because if healthy lifestyle patterns are established earlier, healthcare costs, obesity, and the risk of diseases such as T2D will drastically decrease globally.

**7-11** Examining variations in mental health stigma and its connection to current mental health psychotherapy utilization among Students of Color (SoC) and White Students. **Binula Illukpitiya**, *Lipscomb University, Nashville, Tennessee*. SoC students, like their peers of the same age, face the risk of experiencing mental health challenges. The mental health stigma is associated with concerns such as reduced self-esteem, public labeling, and discrimination. The discourse on mental health stigma often overlooks the influence of academic, financial, and social stressors. This study focuses on examining variations in mental health stigma and its connection to current mental health psychotherapy utilization among SoCs and White students. The data from Healthy Minds Study survey conducted between 2020 - 2021 were used for the analysis. The study findings show that there are lifestyle variations among the minority divisions of SoCs. There was no correlation between personal or perceived public stigma and mental health psychotherapy among minority students. Though the stigma is a primary driver of unmet mental health needs among college SoC, the results suggest that variations exist based on financial, academic, and social factors.

**7-12** Case study of brushite bladder stones in a 7-yr-old neutered male dog. **Annika Jolley\*, Amber DF Moore, Melanie Burnley, Kendall Bass**, *The University of Tennessee Martin, Martin, Tennessee*. While bladder stones are a common issue for canines, recurrence with repeated surgeries for bladder stones are not, especially due to the uncommon stone type - brushite stones. This 7-year-old neutered male dog was diagnosed with brushite bladder stones on multiple occasions and underwent four surgeries to date for stone removal. Brushite stones, also called calcium phosphate stones, are the result of a metabolic disorder. Management of these stones is achieved by proper diet, often a veterinary prescription diet, and avoiding over supplementation of vitamin D and calcium. In this case, management recommendations

were unfortunately not followed by the owner, which has led to recurrence and need for repeated surgical removal. This presentation explores the diagnosis and treatment options for Brushite stones and seeks to improve outlets for client education to improve successful outcomes and positive prognosis.

**7-13** Canine parvovirus: An overview. **Hannah Tienter\***, **Amber DF Moore**, *The University of Tennessee Martin, Martin, Tennessee*. Canine Parvovirus is among the deadliest diseases found in the canine population. A gastrointestinal tract disease, parvovirus is characterized by vomiting and diarrhea with many of the inflicted succumbing to the disease. This virus is hearty and can live in the environment for up to 7 years, making its eradication difficult. Multiple diagnostic tests are available for veterinary use and focus on finding antigen in fluids such as saliva and feces. Treatment is often supportive care and relies on the animal's immune system to fight the disease. Because it is maintained in the wildlife population, efforts have shifted away from eradication toward prevention. "An ounce of prevention is worth a pound of cure" is a familiar adage applicable to parvovirus. Various commercial vaccines are available for the prevention of parvovirus that are shown to be very effective in preventing the disease.

## History of Science Posters

### Combined with Math & Science Teaching Posters

#### Mathematics & Computer Science Posters

**8-01** Potential effects of masking, quarantine, treatment, and vaccines on swine flu. **Helen E. Pennington\***, **Erin N. Bodine**, *Rhodes College, Memphis, TN*. In spring 2009, a novel strain of influenza A (H1N1), commonly referred to as "swine flu", spread rapidly across the world. We developed the novel SQIRTM model to simulate swine flu in Shelby County to determine the potential effect of masking and vaccination on cumulative seasonal influenza infections. We ran simulations comparing varying onsets of mask enforcement simulating a government enforced mask mandate and varying proportions of the population who are vaccinated before the onset of initial infection. Our results suggest that some masking mandate strategies and pre-vaccination levels would be able to reduce cumulative seasonal influenza infections. Consequently, our model results suggest that masking, when done properly, and vaccination can be an extremely effective way of preventing infections and potentially stopping a pandemic from developing.

**8-02** Estimating & modeling the growth of bromeliads. **Helen Udeochu\***, **Alana Wells\***, **Erin N. Bodine**, *Rhodes College*. The plant family Bromeliaceae contains more than 3000 species of rosette-structured flowering plants (commonly known as bromeliads), and includes the pineapple plant and Spanish moss. We use measurements of longest leaf length (LLL) over a three-year period for three species of bromeliads (*Aechmea recurvata*, *Billbergia brasiliensis*, and *Vriesea rafaellii*) grown in a greenhouse in a controlled environment to estimate growth rates and maximum LLL for each species. We fit a Beverton-Holt growth model to the growth data of the three bromeliad species using a linear regression applied to transformed data. We parsed the data in two ways: yearly growth and six-month growth. Our results indicate that *A.~recurvata* has the largest growth rate and the smallest maximum LLL, *B.~brasiliensis* has the largest maximum LLL, and *V.~rafaellii* has the smallest growth rate.

**8-03** Estimating the local time from a rainbow. **Arjun Tan**, *Alabama A & M University, Normal, Alabama*. A method of calculating the solar zenith angle and the local time from the photograph of a full rainbow is found in the literature. This paper describes a method of doing the same from the photograph of a partial rainbow as long as one end of the rainbow meets the horizon. The only measurement needed is the angle between the rainbow end and the horizon from the photograph. The solar zenith angle and the half angle of the rainbow cone can be calculated from this angle from the geometry of the rainbow cone. Next,



the hour angle of the Sun is calculated given the latitude of the location and the declination of the Sun, whence the local time of the occasion is determined.

**8-04** Quantitative schemes for limiting co-authorships in research publications. **Arjun Tan**, *Alabama A & M University, Normal, Alabama*. Many concerns regarding the proliferation of authors in multiple-authored publications, including “gift authorship”, “ghost authorship”, etc., have been raised in the recent years. However, there has been no consensus about a remedy acceptable to all. In this analysis, we propose quantitative schemes to assign commensurable credits to authors of multiple-authored publications which will be fair to both solitary researchers and group researchers. Four distinct schemes, including one based on a geometric sequence and another based on the harmonic sequence, are proposed. It is found that the harmonic sequence scheme is the best compromise to both solitary and group researchers. Finally, a principle of “conservation of author credits” is applied which equates the total author credits of each paper to unity.

**8-05** Some quirks of batting statistics in cricket. **Arjun Tan**, *Alabama A & M University, Normal, Alabama*. In the game of cricket, the meaning of some batting statistics are unclear and need re-examination. We present three cases of ambiguities and provide suggestions. First, by half centuries is meant innings scores between 50 and 99. In order to include all innings of 50 or greater, we propose to introduce a quantity called total half centuries by adding the centuries to the half centuries. This quantity is highly correlated to the aggregate Test runs and therefore best represents the half century statistics. Second, all centuries including the multiple centuries are counted as single centuries, which nullifies the worth of multiple centuries. To represent all centuries, we propose to count double centuries as two centuries, triple centuries as three centuries etc. The correlation coefficient of this quantity with the batting average also increases in this process. Third, Test cricket statistics are included in the First Class cricket statistics, i.e., statistics for non-Test First Class matches are not kept separately. We propose to create a new category for this quantity.

## Microbiology Posters

**9-01** Effects of E-liquid aerosol  $\pm$  flavors on biofilm viability of a multi-species community of oral streptococcal bacteria. **Michael Kalu \***, **Sarah Sperber**, and **Dominic Palazzolo**, *DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Harrogate, Tennessee*. Recently, we reported that 24-hour exposure to flavored E-liquids is detrimental to the growth of individually grown oral streptococcal bacteria. The aim of this investigation is to monitor the viability of biofilm/biomass of these bacteria as a community after exposure to E-liquid aerosol. *Streptococcus gordonii*, *Streptococcus intermedius*, *Streptococcus mitis* and *Streptococcus oralis* were grown overnight. The next day, bacteria was standardized (OD=1.0), combined (1:1:1:1) and seeded in saliva coated plates. Half the plates were exposed to 45-puffs of E-liquid aerosol  $\pm$  flavors (menthol or cinnamon) followed by 24-hour incubation. The remaining plates were incubated for 24-hours followed by exposure to 45-puffs of E-liquid aerosol  $\pm$  flavors. Fluorescent Live/Dead Bacterial Viability Kits were used to determine viability of biofilm/biomass. The results indicate that exposure to 45 puffs of E-liquid aerosol  $\pm$  flavors have no effect on the formation of a viable biofilm/biomass but hinders the viability of an already existing biofilm/biomass.

**9-02** Effects of E-liquid aerosol  $\pm$  flavors on the formation of a biofilm/biomass in a multispecies community of oral streptococcal bacteria. **Sarah Sperber\***, **Michael Kalu**, and **Dominic Palazzolo**, *DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Harrogate, Tennessee*. Recently, we reported that 24-hour exposure to flavored E-liquids is detrimental to the growth of individually grown oral streptococci. The aim of this investigation is to monitor the formation and presence of biofilm/biomass of these bacteria as a community after exposure to E-liquid aerosol  $\pm$  flavors. *Streptococcus gordonii*, *Streptococcus intermedius*, *Streptococcus mitis* and *Streptococcus oralis* were grown overnight. The next day, each strain of bacteria was standardized (OD=1.0), combined (1:1:1:1) and seeded in saliva coated plates. Half the plates were exposed to 45-puffs of E-liquid aerosol  $\pm$  flavors (menthol or cinnamon) followed by 24-hour incubation. The remaining plates were incubated for 24-hours followed by exposure to 45-puffs of E-liquid aerosol  $\pm$  flavors. Bacteria were stained with crystal violet and absorbance at 595

nm served as an index of biofilm/biomass. Results suggest that flavored E-liquid aerosols do not effect the formation and presence of biofilm/biomass in a community of oral streptococci.

**9-03** Effects of electronic cigarette-generated aerosol  $\pm$  flavors on the growth of *Porphyromonas gingivalis*. **William Huff\***, **Creighton Adams**, **Anthony Campbell**, **Makenzie Muley**, **Mariam Shakir**, **and Dominic Palazzolo**, *DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Knoxville, Tennessee*. A balance of commensal and pathogenic bacteria in the oral cavity is required for good oral health. Studies indicate that E-liquids are detrimental to several strains of oral commensal streptococcal bacteria. However, little information is available regarding the effects of E-liquids on oral pathogenic bacteria. For this reason, the anaerobe, *P. gingivalis*, was chosen with the aim of determining the effects of E-liquid aerosols on its growth. Colonies of *P. gingivalis*, initially grown anaerobically on agar, were transferred to a growth media for planktonic growth. At the start of growth, bacteria were exposed to 0, 15, 30 or 45 puffs of E-liquid aerosol  $\pm$  flavors according to CORESTA guidelines and subsequently incubated anaerobically for 0, 6, 18, 24 and 30 hrs. *P. gingivalis* growth was monitored by optical density of the growth media and results suggest that E-liquid aerosol  $\pm$  flavors hinder growth in a puff-dependent manner.

**9-04** Investigating the genetic cause of a hypervirulent mutant in the soft rot pathogen *Pectobacterium versatilis*. **Josie Gannon\***, **Caleb Kersey** and **Korsi Dumenyo**, *Freed-Hardeman University, Henderson, Tennessee (JG, CK) and Tennessee State University, Nashville, Tennessee (KD)*. The phenotype of transposon mutant KD200 of the soft rot pathogen *Pectobacterium versatilis* is characterized by elevated plant cell wall degrading enzymes and increased production of quorum sensing molecules. These phenotypes were believed to be the result of a mutation in the regulatory region of a gene coding for a putative sodium sulfate transporter (NssA). The inability to substantiate NssA's role in this mutant phenotype prompted further analysis of the insertion site. Updated annotation of *P. versatilis*'s genome revealed that the transposon inserted into a potential coding region of a gene directly upstream of nssA. This poster details exoenzyme and quorum sensing data that demonstrate the influence of this unknown gene. We propose that the hypervirulent phenotype produced in mutant KD200 is due to an uncharacterized gene that is serving as a negative regulator of NssA's expression.

## Physics & Astronomy Posters

**10-01** Determining the viscosity of a fluid using *Brownian Motion*. **Keith Hoffmeister\***, **Evan Duet\***, and **Gregory Vieira**, *Rhodes College, Memphis, Tennessee*. A spherical particle in a fluid moving near the wall of a microfluidic environment will experience a lateral fluid drag force higher than it would far from the wall. This increase in drag can be characterized as an increase in effective viscosity of the fluid, as compared with the bulk liquid. Brownian Motion, the continuous and random motion of a particle in a fluid due to collisions with other fast-moving particles and atoms, can be used in the determination of this effective viscosity by analyzing many particle's motions in the fluid with respect to time. Knowing this effective viscosity can be useful for calibration of properties of micro-scale particles, such as determining their magnetic susceptibilities. Using 2.8 micron-diameter particles we measure the effective viscosity of water to be 2.3x higher than it would be in bulk, and a resulting magnetic susceptibility of 0.5.

**10-02** Temperature-dependent speed of sound in distilled water. **Emily E Bingham\***, **Grace I Nehring\***, **Ann M Viano**, **Brent K Hoffmeister**, *Rhodes College, Memphis, Tennessee*. The purpose of this project was to develop a technique for measuring the speed of sound in fluids as a function of temperature using ultrasonic signals. Distilled water was used as an initial test fluid. An ultrasonic transducer was mechanically moved to scan an 0.500-in. precision machined aluminum block step. The step was placed in a 1 L tank containing distilled water. That tank was then placed in an 8 L water bath where the temperature of the distilled water was controlled using a heater and ice packs. Measurements were performed in 0.5 °C intervals from 15.0 °C to 25.0 °C. The time difference between echoes received from either side of the step was then used to calculate the speed of sound in the fluid. The speed of sound was found to increase monotonically with temperature, with a range of 1473 m/s - 1504 m/s for distilled water.

**10-03** Enhancing the phase-change properties of equichalcogenides through bismuth doping. **Yuriy Holovchak\***, **Andriy Kovalskiy**, *Austin Peay State University, Clarksville, Tennessee*. Chalcogenides, due to their phase-change functionality that can be triggered electrically, optically, or thermally, along with their exceptional IR transparency, significant optical nonlinearity, photosensitivity, induced anisotropy, and ease of thin film processing, are ideal for integrated electronic and photonic platforms. Equichalcogenides (a new material family including S, Se, and Te) merge the phase-change switch effect with IR transparency and photosensitivity, becoming well-suited for applications in telecommunications, phase-change non-volatile memory, and neuromorphic computation. In this study, Sb in the Ge-Sb-S-Se-Te phase change material was progressively replaced with Bi, a unique dopant in chalcogenide glasses that can alter the conduction from p-type to n-type and/or form Bi-based nanostructured areas. The formation/elimination of nano/micro crystallites within the initially amorphous equichalcogenide medium through external treatment enables in-situ modification of the phase-change switching effect. Materials from the  $\text{Ge}_{15}\text{Bi}_x\text{Sb}_{40-x}\text{S}_{15}\text{Se}_{15}\text{Te}_{15}$  family ( $x = 5, 20, 40$ ) were prepared and examined using thermal, optical, and X-ray diffraction techniques.

**10-04** Exploration of amorphous Na-GeSe thin films for solid-state battery applications. **Michael Graff\***, **Jair Martinez\***, **Andriy Kovalskiy**, **Roman Golovchak**, *Austin Peay State University, Clarksville, Tennessee*. Flammable organic liquid electrolytes in lithium-ion batteries pose safety concerns, exacerbated by lithium's geopolitical challenges. The surging demand for high-capacity power storage, especially in electric vehicles, necessitates cost-effective all-solid-state batteries to address electrolyte issues. Rechargeable sodium-ion batteries, leveraging suitable cathode materials and solid-state electrolytes, present a solution, with GeSe glasses as strong candidates. This study focuses on creating sodium-containing Ge-Se based amorphous thin films via vacuum thermal evaporation. These films undergo thorough analysis, including scanning electron microscopy and impedance spectroscopy over a wide frequency range from 4 Hz to 8 MHz. Electrical properties are systematically examined using a HIOKI LCR meter and a temperature-controlled LINKAM stage, revealing insights into temperature and frequency dependencies. The variations in electrical parameters with temperature and frequency were employed to derive Cole-Cole relationships. The potential utilization of this material as a solid-state electrolyte for facilitating sodium ion transport is examined.

**10-05** Using three filters from the Hubble Space Telescope to study stellar emissions in Makani. **Jack Harper\***, **David Rupke**, and **Triet Ha\***, *Rhodes College, Memphis, Tennessee*. The Makani Galaxy, at redshift  $z = 0.459$ , gives unique insight into galactic evolution. It has galactic winds traveling at 1000 km/h due to rapid star formation. These winds are unique because of their vastness. It is very rare to see winds extend as far from the galactic core as Makani's. Studying such a galaxy reveals how early galaxies evolve without an active galactic nucleus. The filters used to collect the data were the F150, F165, and F814W filters in the Hubble Space Telescope. Using aperture photometry in Python, the size and magnitude of the wind was obtained. The F150 filter had an ABMAG of 21.794 (+102; -40). The F165 filter had an ABMAG of 21.111 (+256; -127). The F814W filter had an ABMAG of 18.642 (+80; -35). This poster offers a view of where the ongoing project currently stands.

**10-06** Transformation equations between the SDSS and DES magnitudes in Stripe-82. **Meagan Porter\***, **Dr. J. Allyn Smith**, **Dr. Douglas Tucker**, *Austin Peay State University, Clarksville, Tennessee*. We utilize transformation equations derived from a comparative analysis of standard stars in the Sloan Digital Sky Survey (SDSS) and the Dark Energy Survey (DES) Stripe-82 to validate previous DES calculations. SDSS is a comprehensive five-filter survey that acquired both imaging and spectroscopy data for the Northern Galactic Cap. DES is another five-filter survey that utilized similar filters and conducted observations in the Southern Galactic Cap. By leveraging stars located in overlapping areas between DES and SDSS, we have estimated transformation relationships between these two photometric systems. We also investigate transformations between DES and other optical/NIR photometric systems. We find that 1D interpolations offer a straightforward approach, easily implementable using Python's `scipy` routines, which proves to be more robust than conventional polynomial transformation relations.

**10-07** Photometry of TESS MS Stars For Gyrochronology. **Eden Kope\***, **Terry D. Oswalt**, **J. Allyn Smith**, *Austin Peay State University, Clarksville, Tennessee (EK, JAS)*, and *Embry-Riddle Aeronautical University, Daytona Beach, Florida (TDO)*. We are extracting photometric data from a select group of

Transiting Exoplanet Survey Satellite (TESS) main sequence stars which are identified as members of wide binaries. Light curves produced from these data will be used to calculate the rotation rates of the stars and subsequently their ages. Data taken from TESS will also be compared with the extracted data to confirm their rotation periods. These efforts are being used to determine the feasibility of ground-based differential photometry to provide enough precision to detect low-amplitude rotation signatures. These findings will contribute to the Gyrochronology research team at Embry-Riddle Aeronautical University. The images have been taken using the Southeastern Association for Research in Astronomy (SARA) consortium telescopes at Cerro Tololo Inter-American Observatory (CTIO), Kitt Peak National Observatory (KPNO), and Roque de los Muchachos Observatory (RMO). Support from NSF grants AST-1910396 and AST-2108975 and NASA grants 80NSSC22K0622, 80NSSC21K0245, and NNX16AB76G is gratefully acknowledged.

**10-08** Using OOMMF simulations to investigate magnetism at the micro-scale. **Prannoy Lankapalli\***, **Eliza Howard\***, and **Gregory Vieira**, *Rhodes College, Memphis, Tennessee*. The Object Oriented Micromagnetic Framework, or OOMMF, project from the National Institute of Standards and Technology (NIST) allows for magnetic materials to be studied computationally by selecting a material, designing magnetic structure shapes and dimensions, and mimicking experimental conditions. We studied the effects of weak magnetic fields, less than 100x Earth's magnetic field, on microscopic nickel-iron disks using OOMMF simulations to mimic particle manipulation experiments. When subjecting the simulated disks to rotating fields similar to what are experienced experimentally, we note that disks appear to form vortices. This model agrees more closely with experimental data and describes the micromagnetic forces that affect the nickel-iron disks to a higher degree of accuracy.

**10-09** Effect of formalin fixation on ultrasonic properties of bovine brain tissue after a year. **Phyu Sin M. Myat\***, **Amalia M. Bay\***, **Grant R. Jenson**, **Kate E. Hazelwood\***, **Blake C. Lawler\***, **Emily E. Bingham\***, **Cecille Labuda**, **Brent K. Hoffmeister**, and **Ann Viano**, *Rhodes College, Memphis, Tennessee (PSMM, AMB, GRJ, KEH, BCL, EEB, BKH, AV)*, and *University of Mississippi, Oxford, Mississippi (CL)*. The goal of this study was to investigate the effect of formalin fixation on the ultrasonic properties of brain tissue. Two ultrasonic parameters were measured: speed of sound (SOS) and frequency slope of attenuation (FSA), with a 5 MHz transducer on 1-cm thick slices of bovine brain in a tank of phosphate-buffered saline at room temperature. A total of 28 brain specimens from 9 brains were studied at two different time points: a few hours after harvesting (fresh) and after a year of fixation in formalin (year). Results were reported as mean  $\pm$  standard deviation. SOS and FSA of fresh brain tissue were (1524  $\pm$  4) m/s and (0.44  $\pm$  0.06) dB/cm/MHz, respectively. SOS and FSA of brain tissue after a year of fixation were (1535  $\pm$  9) m/s and (0.55  $\pm$  0.11) dB/cm/MHz, respectively. Thus, formalin fixation produced a 0.7% increase in SOS and a 25% increase in FSA.

**10-10** Two-dimensional mapping of the speed of sound of ultrasonic pulses in the brain. **Lauren G. Boughter\***, **Phyu Sin M. Myat\***, **Amalia M. Bay\***, **Grant R. Jenson\***, **Kate E. Hazelwood\***, **Blake C. Lawler\***, **Cecille Labuda**, **Brent K. Hoffmeister**, and **Ann Viano**, *Rhodes College, Memphis, Tennessee (LGB, PSMM, AMB, GRJ, KEH, BCL, BKH, AV)*, and *the University of Mississippi, Oxford, Mississippi (CL)*. With the rapid growth of transcranial ultrasound, it is becoming increasingly important to understand the ultrasonic properties of the brain in more detail. The goal of this study was to create two-dimensional maps of the speed of sound of ultrasonic pulses propagated through slices of brain tissue. A total of 28, 1-cm thick slices of bovine brain were prepared in different orientations from 9 bovine brains. A 5 MHz transducer was mechanically scanned over each slice to measure the speed of sound (SOS) at multiple locations on each slice. The measured SOS values were used to create parametric images of the specimens showing SOS at every measurement location.

**10-11** Evaluating bone density with ultrasound: leveraging wavelet analysis and convolutional neural networks for early osteoporosis detection. **Hugh E. Ferguson\***, **Carl D. Herickhoff**, **Ann M. Viano**, and **Brent K. Hoffmeister**, *Rhodes College, Memphis, Tennessee (HF, AV, BH)*, and *The University of Memphis, Memphis, Tennessee (CH)*. Osteoporosis is a prevalent bone disease with significant implications for a patient's overall health. The early detection of osteoporosis is pivotal for providing timely prevention. This study aims to explore the use of wavelet analysis of ultrasonic backscatter signals from bone and a convolutional neural network (CNN) to predict bone density. A data set of ultrasonic signals

from various bone samples was collected, including high-density and low-density specimens. A wavelet transform was used to generate scalograms that were analyzed by a CNN to predict bone density based on scalograms that trained the model. The CNN trained on the scalograms produced an accuracy that grew to 85% in 8 training steps. This result suggests that wavelet analysis and CNNs may offer valuable insights into bone density evaluation from ultrasound scans.

## Science and Math Teaching & History of Science Posters

**11-01** An ethics in action case study: Accessing the etextbook platform in an asynchronous-online-undergraduate nutrition. **Terra L. Smith, and Loveday E. Nwobilor**, *The University of Memphis, Memphis, Tennessee (TLS) and Shelby Residential and Vocational Services, Memphis, Tennessee (LEN)*. Universities are concerned about the financial demands of academic pursuits. Prompted by professional ethics, nutrition faculty advocated for first-day access of the etextbook platform by students in an asynchronous online-undergraduate course. The purpose of this project is to use a case study analysis methodology equipped with a learning organization theoretical lens to examine from the faculty perspective the experience of organizational conversion into a first-day access of course materials scenario. The tenets of the learning organization theory were condensed into 3-core concepts: shared vision; team learning; and systematic thinking. Each core concept was analyzed from a faculty perspective. Faculty, administrators, and service providers shared the vision of immediate access to course resources by students. More ambivalent was the level of agreement on the team composition and the importance of learning as a team. In terms of systematic thinking, the technological set-up was deployed effectively. However, faculty concerns are on-going.

**11-02** Undergraduate math students' thinking and challenges when representing distance in the Cartesian plane. **Parth Sinojia\*, Catherine Althoff\*, Shalya Garrison\*, Samuel Lippe\*, Lauren Surratt\*, Jude Shive\* and Erika David Parr**, *Rhodes College, Memphis, Tennessee*. The purpose of this poster presentation is to highlight the variations in student thinking when working with difference expressions in the Cartesian plane — a fundamental skill crucial for grasping numerous Calculus concepts. Despite its pivotal role, previous research has shown students often struggle to conceptualize and express distances. We surveyed  $n=169$  undergraduate math students to evaluate their ability to represent distances within the Cartesian plane using expressions in terms of both  $x$  and  $y$ . Through analysis of the responses, we identified two crucial components for completing the tasks: a) using a magnitude interpretation of subtraction and b) establishing the Cartesian connection. We found a significant proportion of students did not use either of these components appropriately, leading them to incorrect responses. Our findings show a need for instruction on the skills foundational to understanding distances in the Cartesian plane within Calculus education.

**11-03** Impact of using a hormone recap table and oral presentations on students' learning in upper division classes including endocrinology. **Lauren Milam\*, Xavier Jimenez\*, and Donald Shaw**, *The University of Tennessee at Martin, Martin, Tennessee*. Instead of traditional lecturing in classes, approaches of active learning were adopted in an endocrinology class. The first approach used a hormone recap table requiring students to investigate one hormone at a time and investigate in-depth understanding over several aspects of the hormone. The second approach asked each student to make a 15-min oral presentation over a primary literature followed by a 7-min moderation of class discussion. We hypothesized adoption of these strategies would increase learning performance and teaching effectiveness. Our results showed, first, scores of regular exams in active learning classes were significantly higher in two out of three exams. Second, students' surveys strongly agreed that the hormone recap table was helpful on exams and to their understanding of the subject. Third, the class with active learning approaches had excellent teaching evaluation scores. These results suggest that classes using active learning strategies increase learning performance and teaching effectiveness.

**11-04** Cowpox and how vaccines came to be. **Caitlyn Henry\*, Amber DF Moore, and Diana Watson**, *The University of Tennessee Martin, Martin, TN*. Smallpox is one of the most devastating viruses mankind

has ever faced with millions of people killed before its eradication. Prior to the first vaccination, doctors used variolation to diminish the deaths from the virus. A person was exposed directly to the virus by material from a pustule on a mildly infected person. While this method was widely accepted as a means of prevention, Edward Jenner's observations shifted the collective's management of disease and ultimately how we prevent diseases today. He first noticed milkmaids seemed to be immune from Smallpox. Sarah Nelms, a milkmaid, had fresh sores on her hand caused by her occupation. Jenner later discovered cowpox, a virus similar to smallpox with milder clinical disease. This led to Jenner's first experiment studying cowpox and later to the invention of vaccinations and the eradication of smallpox, changing the face of disease prevention forever.

## Zoology Posters

**12-01** Mortality of Eastern Bluebirds following a severe winter storm: screening for clostridial enteritis. **Natalie M. Marques\*, Autumn E. Reeves\*, Linda K. Husmann, and H. Dawn Wilkins**, *University of Tennessee at Martin, Martin, Tennessee*. Eastern Bluebirds (*Sialia sialis*) communally roost during the winter, possibly to conserve heat. During severe winter storms, food resources can be difficult to find when covered with ice and snow. Eastern Bluebirds have been found dead in nest boxes during the winter following severe snowstorms. In 2021, 90 dead Eastern Bluebirds were collected from nest boxes in northwest Tennessee and southwest Kentucky. The stomachs (proventriculus and ventriculus) were removed. The majority of the stomachs contained blood. Since *Clostridium perfringens* and *Clostridium colinum* have been documented to cause avian enteritis, we cultured the ventriculus and proventriculus for anaerobes using standard bacteriologic techniques. The proventriculus and ventriculus of 10 birds were cultured on Shahidi-Ferguson Perfringens (SFP) agar. The ventriculus of another ten birds was cultured in thioglycolate broth and then anaerobically on blood agar. Work is ongoing to characterize these isolates and to elucidate the possible cause(s) of mortality in these birds.

**12-02** Mortality of Eastern Bluebirds following a severe winter storm: Did they starve? **Autumn E. Reeves\*, Natalie M. Marques\*, and H. Dawn Wilkins**, *University of Tennessee at Martin, Martin, Tennessee*. Eastern Bluebirds (*Sialia sialis*) roost communally during the winter, possibly to conserve heat. During winter storms, food resources can be difficult to find when covered with ice and snow. Bluebirds have been found dead in nest boxes following severe snowstorms. In 2021, Bob and Judy Peak collected 90 dead bluebirds from nest boxes at Land between the Lakes in northwest Tennessee and southwest Kentucky. Our goal was to determine if these bluebirds show signs of starvation. Specifically, we hypothesized that their stomachs would be empty suggesting that they were unable to find food before roosting the night that they died. The stomachs (proventriculus and ventriculus) were removed and their contents inventoried. Most of the stomachs were empty, however, few contained plant fibers, seeds, and/or parts of arthropods. Unexpectedly, many stomachs contained varying amounts of blood. We are investigating factors that may contribute to this accumulation of blood in the stomachs.

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