131st Meeting

of the

November 6, 2021

This meeting is hosted by Tennessee Technological University

Celebrating 109 Years

Tennessee Academy of Science Institutional Sustaining Members

Austin Peay State University
East Tennessee State University
Middle Tennessee State University
Motlow State Community College
Rhodes College
Tennessee Technological University
The University of Tennessee at Martin
The University of the South
Volunteer State Community College

www.tennacadofsci.org

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

2022 – Tennessee State University
2023 – Rhodes College

Table of Contents

Welcome . . .

... to the 2021 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.

Announcements

If they are not already TAS members, presenters and attendees may become members by mail or on the TAS website: ***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

Thank you . . .

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

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

Meeting Schedule

Zoom links can be found on the Annual Meeting Web page
(http://www.tennacadofsci.org/annual_meeting/general_info.php)

All times listed are CENTRAL STANDARD TIME

Friday, November 5, 2021

2:30 pm until 4:30 p.m.	**Executive Committee Meeting**

Saturday, November 6, 2021

7:30 a.m. until 1:30 p.m.	**Registration, Stonceipher Lecture Hall (SLH) Lobby**
8:15 a.m. until 8:30 a.m.	**Poster Session Sign In, SLH Lobby**
8:30 a.m. until 9:45 a.m.	**Poster Presentations and Judging, Laboratory Sciences Commons (LSC) Main Hallway**
10:00 a.m. until 10:30 a.m.	**TAS Annual Business Meeting, SLH 113 and 126**
10:30 a.m. until 11:30 a.m.	**Welcome by TTU President, Dr. Phil Oldham, followed by the Plenary program presented by Dr. Adam Holley, Associate Professor, Department of Physics, Tennessee Technical University** **Title: "The Tortoise and the Hare: A Race for Answers to Big Questions about the Universe"** **SLH 113 and 126**
11:30 a.m. until 1:00 p.m.	**Lunch Break – Einstein Bagels in the Laboratory Sciences Commons area**
1:00 p.m. until 3:20 p.m.	**Section Business Meetings and Oral Presentations**
3:20 p.m. until 3:30 p.m.	**Judges Meeting, LSC 1119**
3:30 p.m. until 4:30 p.m.	**Student Awards Ceremony, SLH 113**

Meet our Keynote Speaker

Dr. Adam Holley

Tennessee Technological University

Adam Holley grew up in Raleigh, North Carolina, but attended college in Pennsylvania, where he earned a B.S. in physics and mathematics from Haverford College. Uncertain about whether theoretical or experimental physics was right for him, he temporized by teaching high school physics in New York City, where he had the good fortune to collaborate on the development and teaching of a three-year research course for high school students. That experience ultimately helped him decide to become an experimentalist. This he did at North Carolina State University, joining a group of scientists developing the United States' first ultracold neutron (UCN) source at Los Alamos National Lab. He earned his Ph.D. as part of the associated UCNA experiment that for the first time used UCN to measure the neutron beta decay asymmetry. During his subsequent postdoc at Indiana University, Dr. Holley got involved in another beta decay experiment called UCNτ. He continued his involvement with that effort when he joined the faculty at Tennessee Tech, where he leverages unique aspects of UCN physics to involve undergraduates in the work.

The Tortoise and the Hare: A Race for Answers to Big Questions about the Universe

The production of energetic exotic particles has long been a primary method for discovering the rules that underlie what we observe about the universe. There are, however, a number of gaps in this understanding, which the study of more familiar systems, such as neutrons, atoms, or molecules, can help elucidate. As the overall precision of these experimental efforts increases, there are a growing number of tantalizing anomalies, any of which could point the way to a shift in our understanding of how the universe formed, what makes it up, and whether ours is the only universe or is one of many universes. The race to discover new fundamental physical behavior currently features a diverse array of high-precision approaches, spanning an enormous range of energies. “Ultracold” neutrons (UCN), with twenty orders of magnitude smaller energies than particles produced at the Large Hadron Collider, provide one example of how low-energy measurements can facilitate the requirement for high precision. A classic example of a UCN-based experiment is determination of the free neutron lifetime, an empirical observable involved in a number of potentially interesting anomalies. An experiment called UCNτ that operates at Los Alamos National Laboratory has set the standard for precise determinations of this quantity. Using UCNτ as an example of the physics, engineering, and computational challenges high-precision work entails, this talk will describe the ongoing race to answer some long-standing questions about the universe.

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

Oral Presentations

Agriculture-1

Chair: Dr. Anthony Witcher

1:00 pm – 3:20 pm

Prescott Hall 222

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

1:05-1:20 Tennessee agriscience teachers' perceived level of importance toward and competence in teaching food science. ***Dennis Duncan, Chaney Mosely, and Will Bird***, *Tennessee Technological University, Cookeville, Tennessee, Middle Tennessee State University, Murfreesboro, Tennessee, and University of Tennessee at Martin, Martin, Tennessee*. The purpose of this study was to determine Tennessee agriscience teachers' perceived level of importance for the TN Department of Education Food Science program of study standards, and their level of self-efficacy toward teaching those standards. More specifically, one of the research objectives was to determine in-service training needs associated with 19 of the 34 items that are directly linked to educational programming and ServSafe. Forty-two percent to 92% of teachers identified each of the 19 items as important or very important; as few as 17% to as many as 69% of teachers self-reported that they felt either competent or very competent performing the 19 items directly related to the Food Science standards. Additionally, 83% of teachers felt it important to very important to teach about procedures specific to equipment, safety, sanitation, and quality control; but just 50% to 69% reported being competent or very competent in performing each task.

1:20-1:35 How much do undergraduate students learn while participating in summer internships at an agriculture research station?: A look at two years of interns' content knowledge assessments during the Research and Extension Experiences for Undergraduates (REEU). ***Kendall Sheldon, Rachel Guyer, Heather Kelly, Avat Shekoofa, Will Bird, and Joey Mehlhorn***, *University of Tennessee-West Tennessee Research and Education Center, Jackson, Tennessee and University of Tennessee-Martin, Martin, Tennessee*. The Research and Extension Experiences for Undergraduates (REEU) is a USDA-NIFA funded internship program designed to expose students to agriculture research and extension experiences. During summers 2020 and 2021, the West Tennessee AgResearch and Education Center (WTREC) hosted 17 and 18 (respectively) interns in eight different departments including cotton agronomy, crop physiology, entomology, plant pathology, soil and nutrient management, soybean and corn agronomy, systems agronomy, and weed science. This study evaluated how summer interns' agriculture industry and research knowledge changed throughout this program. A content knowledge assessment was developed by the internship coordinator and administered to interns three times (pre, mid, and post) each summer. Results indicate that 2020 interns had a 27% knowledge gain and 2021 interns had a 29% knowledge gain from pre to post assessments. It can be concluded that the internship experiences have increased the self-perceived knowledge levels of the REEU program learning outcomes.

1:35-1:50 Integrating environmental and sustainability issues in the German-English Speaking Classroom. ***Lena Hopmann*, Alexandra Bittel* and Rachna Tewari***, *Technische Universität Braunschweig, Braunschweig, Germany (LH, AB), and The University of Tennessee at Martin (RT)*. Environmental and sustainability issues are of interest to most demographics and emerge as a key topic of concern and discussion in the society. It is imperative to integrate these topics into classrooms at various levels to enhance environmental awareness among young students. This study outlines the teaching strategies used to incorporate the aforementioned topics in German-English speaking classrooms. The lessons are designed to improve skills in reading comprehension, speaking, writing and listening comprehension. Since problems concerning the environment, such as pollution and climate change play a major and topical issue in our society, they are often dealt with in English classes. Realistic vocabulary is taught and the awareness of global events as well as an ecological approach are thus strengthened. Pictures and videos are used to introduce the topic, and class discussions are often included. At the end, a presentation or an essay is required to assess student learning.

1:50-2:05 Detection of *Phytopythium vexans* using loop-mediated isothermal amplification. ***Bhawana Ghimire*, Farhat A. Avin, Sumyya Waliullah, Md Emran Ali, and Fulya Baysal-Gurel***, *Tennessee State University, Otis L. Floyd Nursery Research Center, McMinnville Tennessee (BG, F A.A and FBG) and University of Georgia Tifton, Tifton, Georgia (SW and MEA). Phytopythium vexans* is an important water borne and soil inhabiting oomycete pathogen causing root and crown rot of plants. Early and accurate detection of this pathogen in the nursery production system is critical, as it can circulate in the irrigation water and cause recurring disease outbreak. Conventional bait-based methods are difficult and tedious. Hence, time-efficient molecular diagnostic methods could help overcome the limitations of traditional identification. In this study, a loop-mediated isothermal amplification (LAMP) assay was developed for identification of *P. vexans*. Among the several sets designed, LSU2 primer was found to be specific to *P. vexans* as it did not amplify other closely related species. The developed assay was able to amplify pathogen DNA up to 102 fg/ul. The reaction was optimized at 71°C for 60 minutes in a 25ul reaction mixture. The reaction results were observed by real-time LAMP, gel-electrophoresis, warm-start colorimetric dye, and SYBR™ Green-I-DNA staining.

2:05-2:20 Comparative performance of fungicides, biofungicides, and host plant defense inducers in management of *Phytophthora* root rot on boxwood. ***Sandhya Neupane* and Fulya Baysal-Gurel***, *Tennessee State University, Otis F. Floyd Nursery Research Center, McMinnville, Tennessee*. *Phytophthora* root rot caused by *Phytophthora nicotianae* can affect all growth stages of container grown boxwood plants. As part of an integrated approach, the efficacy of fungicides, biofungicides, host plant defense inducers, and fertilizer against *Phytophthora* root rot of boxwood was assessed in greenhouse conditions for years 2019 and 2020. Pots were inoculated with *P. nicotianae* grown on rice grains. Total fresh weight and total root weight were recorded, and roots were assessed for disease severity using a scale of 0-100% roots affected. At the end of both trials, treatments that significantly reduced *Phytophthora* root rot severity were Agrifos, Empress Intrinsic, Orvego, Rootshield Plus WP, Segovis, and tank mix of Fertilizer ON GUARD + Rootshield Plus WP, and root rot disease severity was not significantly different from non-inoculated boxwood plants. No significant differences between the plants treated with different treatments were observed for weight parameters.

2:20-2:35 Measurement of drought-induced physiological changes in flowering dogwoods in a container production system. **Krishna Neupane*, Anthony Witcher, and Fulya Baysal-Gurel**, *Tennessee State University, McMinnville, Tennessee*. Flowering dogwoods are important ornamental trees but sensitive to drought stress. An outdoor study was conducted to measure different physiological parameters in drought conditions. The trees were organized in a randomized complete block design with three irrigation treatments applied at 125%, 25% and 10% (control, moderate, and severe drought, respectively) based on average daily water usage (evapotranspiration). Normalized Difference Vegetation Index (NDVI) and leaf moisture potential (PMS) were recorded weekly for one month. At the end of the study, final height, width, root weight and total weight were recorded. There were no significant differences in plant total and root biomass, but height and width were greatest for controls. NDVI was significantly higher in controls than other treatments in 7th, 14th, 21st and 27th day. There were no significant differences for PMS on day 7 but was greatest for controls on 14th, 21st and 27th day.

2:35-2:50 Resilience of local food supply chain during pandemic: An examination of opportunities and constraints of marketing local foods. ***Blessing Ajumobi* and Prabodh Illukpitiya***, *Tennessee State University, Nashville, Tennessee*. Consumer preference for less processed food naturally creates an opportunity for producing and marketing high quality food to satisfy consumer demand. The logistics breakdown in the agricultural sector during COVID-19 pandemic and food shortage shows that an adequate and comprehensive research on local food market system has widely been neglected. The purpose of the study is to evaluate the performance of existing farm-to-consumer marketing efforts, to better understand the potential for expanding market for local producers, and to identify barriers that are preventing producers and consumers from utilizing the local food marketing network. We analyzed primary data collected from local food producers via online survey to examine the options found in the production and marketing of local food in Tennessee. The results of the statistical analysis of nine different marketing channels used by the respondents in this study demonstrated how the demographical variables impact the choice of each marketing channel.

2:50-3:05 Incorporating mung bean in farm production systems: A comparative economic analysis. ***Daiva Wilson*, Prabodh Illukpitiya, Dafeng Hui, and Fisseha Tegegne***, *Tennessee State University, Nashville, Tennessee*. Mung bean has potential as an alternative crop for small and medium-sized farmers in the southeastern region. Given the importance of educating farmers in economic benefits from producing mung bean, the major objective of the research is to assess the economic benefits in mung bean production. The grower's overall objective is to maximize profit, which is the net return from their enterprise. The key variables determine the profit depends include production costs, yield and price of mung bean. Production costs data were based on input application from experimental plots and published secondary data sources. We analyzed production costs from field preparation up to harvesting and prepared enterprise budgets. Then using Monte Carlo simulation, we created unit costs, price and yield distribution to capture the variability and performed profitability analysis. The analysis showed that mung bean could generate positive net return for farmers hence a viable crop for farmers in Tennessee.

3:05-3:20 Whole genome amplifications towards molecular markers' analysis of sweet sorghum microspores. ***Dilovan Yahya* and Ahmad Aziz***, *Tennessee State University, Nashville, Tennessee*. Five varieties of *Sorghum bicolor* (Achi Turi, Dale, Dasht Local, Topper 76-6, and Tx 430), potentially released for biofuel uses, were maintained and monitored. A total of 170 microspores, released immediately after the meiosis stage, were harvested and individually isolated using micro-injector mounted over a micromanipulator. Free early microspores were lysed, and their genomes multiplied through multiple displacement amplification. Whole genome amplifications yields were quantified using a spectrophotometer and confirmed by gel electrophoresis. The UV absorbance (A230/260) readings of 1.8 for single cell DNAs with 2800 - 3000 (ng/µL) range indicated high quality and amounts. DNA extractions of parental leaf tissue were conducted for KASP primers' ordering towards single nucleotide polymorphism (SNP) analysis. Thus, genetic variations among microspore (individually isolated as natural haplotypes) populations will be measured to identify segregation of parental DNA markers. Per this report, gamete merit based genetic assessments are facilitated while reducing the cost of analysis.

Agriculture-2
Chair: Dr. Anthony Delmond
1:00 pm – 3:20 pm
Prescott Hall 226

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

1:05-1:20 Diversification opportunities for bioenergy feedstock production in southeastern region. ***Kabirat Nasiru* and Prabodh Illukpitiya***, *Tennessee State University, Nashville, Tennessee*. The need to find and use a broad range of alternative feedstock is enormously fueled by the desire to meet energy demands and ensure energy security in the U.S. This paper analyzes the economic feasibility and profitability of biomass sorghum as a lignocellulosic feedstock for bioenergy market in southeastern region. Management information including site specific input applications and associated input costs were collected from six project sites in four states (Texas, Mississippi, Alabama, and Florida). We produced site-specific enterprise budgets to assess production costs in biomass sorghum based on the site-specific input application. In next step, we performed Monte Carlo simulation to determine the potential range of net returns by analyzing unit costs of inputs, biomass yield of sorghum and energy cane, and dry matter price variations. The simulation results show potential for profit from growing biomass sorghum in the region depending on biomass yield and market prices.

1:20-1:35 Comparative field growth patterns and sugar yields of five sweet sorghum varieties. ***Trinity Gourdin, Aron Felts, and Ahmad Aziz***, *Tennessee State University, Nashville, Tennessee*. Five varieties of sweet sorghum (Achi Turi, Dale, Dash Local, Topper 766, and TX 430) were grown at the Tennessee State University campus farm. All have varied combinations of phenotypes such as short vs. tall stalks and short/oval panicle vs. tall/long/slender panicles. Also, the difference in number of healthy tillers and Brix values of sugar extract yielded was noted. TX 430 had less sugar water (Brix value) compared to Achi Turi. The Brix value is a significant indicator for sweet sorghum varieties because the sugar water extracted from the stalks can be used to create molasses or syrup. Analyzing the growth rates for field-grown plants reveals the genetic difference and potentials of different varieties. Sweet sorghum is mainly cultivated for syrup production or forage uses, however, some large-growing varieties with ear heads full of grains serve as human food, livestock feed, or biomass feedstock.

1:35-1:50 Assessing the effect of winter canola *Brassica napus* L. varieties on seed yield, oil, and protein content in Tennessee. ***Manasarobar Bhattarai * and Jason de Koff***, *Tennessee State University, Nashville, Tennessee.* Canola *Brassica napus* L. is an oilseed crop and is a source of healthy cooking-oil, animal feed by-products, biodiesel, a good cover crop and rotation with winter wheat. The demand for canola has been increasing; however, some of the demand can be fulfilled by introducing high yielding varieties and adapting the varieties that grow during the winter season. As new varieties are introduced there is a continuous need to identify how they perform in new areas like Tennessee where less research has been performed. In fall 2020, a study was initiated at the Tennessee State University Agricultural Research and Education Center in Ashland City, TN with 24 varieties (10 open-pollinated and 14 hybrids) in a randomized complete block design with four replicates, and harvested in June 2021. The results of yield, oil and protein content of varieties will be discussed and will provide with updated options for farmers production system.

1:50-2:05 Mid-south agricultural producers' perception and knowledge on the soil carbon market to potentially mitigate greenhouse gas emissions. ***Tamara Sterrett*, Rachna Tewari, Joey Mehlhorn, and Isaac Lepcha***, *University of Tennessee Martin, Martin, Tennessee*. The United States is back in the Paris Climate Agreement, and one of the goals is to decrease the country's overall greenhouse gas emissions. Creating a market-based approach is a key aspect of the agreement, that involves emission markets and trading. This could create a potential incentive for producers to shift to more sustainable farming practices with the use of carbon credits. If there was an implementation of a soil carbon market, it is important that policymakers understand the farmer's knowledge, incentives, and challenges for entering the market. This study utilizes an online survey questionnaire to examine the perceptions and knowledge of farmers in the mid-south region of the United States about the soil carbon market along with the potential incentives and challenges they may face. Expected results will discuss the existing knowledge and interest among producers regarding management practices aimed to reduce the carbon footprint of agricultural production.

2:05-2:20 A comparative study of carbon emissions through conventional and no-till management practices in West Tennessee. ***Anna Gafford*, Rachna Tewari, and Joey Mehlhorn***, *University of Tennessee at Martin, Martin, Tennessee*. Greenhouse gas emissions have been a significant contributor to climate change over the past several decades. Climate change has caused unpredictable changes in the weather pattern during growing seasons, which is adversely affecting the overall quality and quantity of global crop production. Agricultural operations are using the practice of soil sequestration to help reduce overall carbon emissions. Existing research in Tennessee in this area of climate change lack focus on reducing carbon emissions in agriculture. The purpose of this study is to assess how different cropping practices in West Tennessee impact the environment. Primary data was collected through crop acreage data from the National Agricultural Statistics Service and crop budgets from the University of Tennessee Extension. Carbon emissions were calculated for inputs such as fertilizers and chemicals per acre. Results suggest that conventional till practices showed slightly lower carbon emission levels for fertilizers and chemicals, than in no-till practices.

2:20-2:35 A comparison study of cattle auction bids with climate data for the states of Tennessee and Kentucky. ***Montana Wright*, Rachna Tewari, and Joey Mehlhorn***, *University of Tennessee at Martin, Martin, Tennessee*. Cattle operations across the United States face a unique range of challenges ranging from infectious diseases, forage quality, availability issues, and unpredictable auction bids, all of which could be partially attributed to fluctuating weather patterns. This study examines if cattle auction bids in different categories of weights and classes of cattle are correlated with climatic parameters for the states of Tennessee and Kentucky. The methodology for this study included collecting data for cattle weights and auction prices from the United States Department of Agriculture's Agricultural Marketing Service. Climate data is collected from the National Centers for Environmental Information. A correlation analysis and linear regression will be conducted to establish a relationship between climate data and cattle weights and prices. Results from the study could provide producers with a better understanding of climatic parameters and potentially study the impact on auction bids for the state of Tennessee and Kentucky.

2:35-2:50 Antimicrobial resistance patterns of commensal bacteria isolated from goat farms in Tennessee. ***Tobenna Aniume*, Agnes Kilonzo-Nthenge, Abdullah Mafiz, and Ramasamy Ravi***, *Tennessee State University, Nashville, Tennessee.* Zoonotic transmission of antibiotic resistance is a major burden to animal production and public health. The aim of this study was to determine the occurrence of antimicrobial resistant bacteria in small goat farms in Tennessee using traditional and biochemical methods. Antibiotic sensitivity was tested using the Kirby-Bauer disk diffusion method. *E. coli* in soil displayed a significantly ($p<0.05$) higher resistance to erythromycin (91.3%) compared to doxycycline (56.5%), cephalothin (17.4%) and ampicillin (8.7%). All bacteria isolates were 100% resistant to Bacitracin. A total of 14 multidrug-resistant patterns were displayed among 81 bacteria isolates. Of these, 18 (22.2%) *E. coli* exhibited multidrug resistant pattern B-DO-E; which was significantly ($p<0.05$) different from other bacteria analyzed. Similarly, the highest resistance profile revealed was AMP-AZM-B-CFM-CPD-CF-DO-E by 3 *E. coli* isolates (3.7%). Pathogenic strains of *Salmonella*, *Enterococcus* and *Listeria* showed 100% resistance to vancomycin, novobiocin, tetracycline and kanamycin. Goat farms are reservoirs of multidrug resistant bacteria.

2:50-3:05 Comparing the accuracy of whole blood, serum, and milk for pregnancy diagnosis in cattle. ***Zach Forsythe*, Diana Watson, Ross Pruitt, and Jason Roberts***, *University of Tennessee at Martin, Martin, Tennessee*. Pregnancy testing in beef cattle is important to detect pregnancy early in gestation. Multiple types of blood and milk tests are available to detect pregnancy-specific glycoproteins early in pregnancy. This test compares the accuracy of blood pregnancy and milk pregnancy tests to the ultrasound test of AI pregnancies. A total of 35 beef cattle were tested by blood, milk and ultrasound. On day 28 post-breeding, ultrasound showed 24 cattle pregnant. The sendoff test results confirmed 19 cattle pregnant for 79% accuracy. The chute side test results showed 27 cattle pregnant with 3 false positives resulting in 87% accuracy. The milk test results showed 14 cattle pregnant with 58% accuracy. An economic analysis was performed. Results from the blood sendoff test, showed it is most accurate compared to ultrasound.

3:05-3:20 Comparison of costs associated with timed versus heat detection synchronization in cattle. ***Kiersten Bell*, Diana Watson, Ross Pruitt, and Jason Roberts***, *University of Tennessee at Martin, Martin, Tennessee.* Estrus synchronization is a widely used and accepted breeding livestock technology. The objective of this study is to compare a timed versus heat detection synchronization method to analyze the cost associated with the conception rate of a herd of cattle. This project utilizes the beef cattle on the University of Tennessee at Martin's Teaching & Demonstration Farm. Cattle producers historically operate on a narrow profit margin and our goal is to help identify a more efficient means of breeding when using artificial insemination. Initial results indicate that labor plays a major role in the overall cost effectiveness and must be considered when deciding on what protocol works best for a single herd.

Botany and Cell & Molecular Biology
Chairs: Mr. Cooper Breeden & Dr. Nikki Glenn
1:00 pm – 2:20 pm
Laboratory Science Commons 1205

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

1:05-1:20 Investigation of reproductive biology in *Lilium formosanum* Wallace (Liliaceae): Animal visitation, floral phenology, and floral rewards in Monterey, Tennessee. **Cassandra Fink* and Shawn Zeringue-Krosnick**, *Tennessee Technological University, Cookeville, Tennessee*. *Lilium formosanum*, endemic to Taiwan, has escaped from cultivation and appears to be naturalizing across the Southeast. Recently, a population of ca. 100 individuals have been documented on the Cumberland Plateau in Putnam County, Tennessee. Little is known about the reproductive biology of this species or its potential to become invasive. Plants appear to be self-compatible, produce hundreds of seeds per fruit, and flower in their first year from seed. A preliminary study was conducted to document animal visitation, nectar volume, and phenology. Nighttime observations were conducted for eight days. Visitation events were observed between 2000 and 0000 hours, with five visits from *Manduca sexta* (tobacco hornworm) and one from *Conocephalus* (bush-cricket). Floral nectar volume ranged from 35-75 µl. On average, anthesis lasted 6 days and flowers were protogynous. Although this species may exhibit invasive characteristics, it may also serve as an important food source for nocturnal insects.

1:20-1:35 Pollen limitation and reproductive biology of short's bladderpod, *Physaria globosa*. **Emily Powell**, *Tennessee Technological University, Cookeville, Tennessee*. *Physaria globosa* (Desv.) O'Kane & Al-Shehbaz (Short's bladderpod), is a Federally endangered species limited to 31 populations. To inform the recovery of *P. globosa*, pollen limitation was evaluated for five populations: two in Tennessee, two in Kentucky, and one in Indiana. Ten plants from each population served as focal plants; for each plant, 10 flowers received pollen via natural pollinator visitation and 10 received supplemental pollen. After 48 hours, pistils were collected, stained, and visualized under fluorescence to quantify pollen germination and growth. Ovaries with four or more pollen tubes were scored as successfully fertilized as the number of ovules per pistil in this species is 4. Results indicate pollen limitation is a significant factor ($p < 0.0001$) affecting reproduction in four of the five populations; the fifth was a TN population ($p = 0.49$). Data suggests that pollinator abundance and low pollen diversity may be negatively affecting *P. globosa*.

1:35-1:50 A volunteer-based approach to surveying species occurrences of rare and listed flora on and adjacent to the Southern Cumberland Plateau of central Tennessee. **Lillian V. Fulgham* and Oliver B. Hutchens***, *Sewanee: The University of the South, Sewanee, Tennessee.* Student research fellows with the Sewanee Herbarium worked under the direction of the Tennessee Plant Conservation Alliance this summer to test the viability of volunteer-based research in regards to surveying plant populations of concern. Maps containing historical element occurrence (EO) data and managed areas in and around Sewanee, TN were displayed using ArcGIS Online, while associated applications such as ArcGIS Collector were used to map occurrences in the field and record site-specific observations. After a brief training and information session, fellows navigated to the historical population occurrences using GPS coordinates and utilized herbarium resources to confirm species identification. While only one fellow had received prior training in GIS, both quickly gained sufficient proficiency after the first few days in the field and, although both were already familiar with basic taxonomy and plant identification, with proper training it is expected that volunteers with less prior experience could also conduct surveys successfully.

1:50-2:05 Cryopreservation of mass harvested Sweet Sorghum microspores for downstream applications. **Aron Felts*, Dilovan Yahya, Trinity Gourdin, and Ahmad Aziz**, *Tennessee State University, Nashville, Tennessee.* Sweet sorghum has been gaining more prominence due to its C4 capabilities that allows growth on less arable lands even in hot weather with fewer water requirements. Due to the short flowering window per panicles' availability, a cryopreservation protocol is required for microspore based research. Thus, the protocols presented here, including microspores mass isolation that allows for year round supply. Flowering stages of five varieties were monitored to harvest immature gametes at their natural protoplast stage from spikelets, which were crushed in mannitol to release free microspores. The resulting solutions were filtered and the pellet of microspores were collected after centrifugation. For cryopreservation, 0.9ml of the resuspended cells were aliquoted with the addition of 5% DMSO and 5% glycerol to facilitate process. Microspore density was observed to ascertain viability of cryopreserved cells. These developed microspores processes would facilitate future endeavors in hemizygous genetic analyses and generating androgenic transformed calli.

2:05-2:20 Isoform specific role of Glycogen Synthase Kinase-3 in high-fat diet induced glucose intolerance. **Jacob J. Lemon*, Prachi Umbarkar, Sultan Tousif, Manisha Gupte, and Hind Lal**, *Austin Peay State University, Clarksville, Tennessee (JL, MG), and University of Alabama, Birmingham, Alabama (PU, ST, HL).* Glycogen synthase kinase 3 (GSK-3), an enzyme that regulates the rate-limiting enzyme of glycogen synthesis, is implicated in the pathogenesis of Type 2 Diabetes Mellitus. The GSK-3 family consists of two isoforms: alpha (α) and beta (β), and both have numerous overlapping and unique functions. It is, therefore, essential to acquire more knowledge on isoform-specific functions of GSK-3s in various disease models. Unfortunately, most studies have used GSK-3 inhibitors that cannot discriminate between the two isoforms. Therefore, using ROSA26CreERT2 GSK-3α-/- and GSK-3β-/- knockout mice, we studied the isoform specific roles in obesity-induced glucose intolerance. Both, deletion of GSK-3α or β isoforms protected mice against obesity-induced glucose intolerance. While, GSK-3β inhibition protected mice against obesity-induced glucose intolerance initially, this effect was blunted with chronic obesity. For control fed, GSK-3β inhibition significantly improved glucose tolerance. Thus, our data suggests that GSK-3β inhibition protects mice against obesity-induced glucose intolerance in a weight-dependent manner.

Chemistry
Chair: Dr. Wilson Gichuhi
1:00 pm – 3:20 pm
Laboratory Science Commons 1201

1:00-1:05 Business Meeting

1:05-1:20 Consonance of simulations and experiments - dynamics of peptide ion collisions with organic surfaces. **Subha Pratihar**, *Tennessee Technological University, Cookeville, Tennessee*. The collisions of protonated peptide ions with organic surfaces include a wide variety of physical and chemical processes as described above, with particular interest in surface induced dissociation (SID), soft landing (SL), and reactive landing (RL). Different simulation approaches are used, and identified as MM, QM + MM, and QM/MM dependent on the potential energy surface used to represent the peptide-H+ + surface collision. The chemical dynamics simulations provide important information concerning: collision energy transfer to the internal energy of peptide-H+ and to the surface; probabilities and mechanisms for SL, proton migration within peptide-H+, peptide-H+ fragmentation, and formation of complexes between the fragments. Atomistic motions obtained from the simulations provide insight into the mechanisms for SL, RL, and SID, such as shattering. The combined efforts of experimentalists and computational/ theoretical scientists help enrich the knowledge and hence a better understanding of the dynamics associated with collisions of peptide-H+ ions with organic surfaces.

1:20-1:35 Anion photoelectron spectroscopy of deprotonated benzonitrile. **Rebecca Firth*, Taylor Dimino*, and Wilson K Gichuhi**, *Tennessee Technological University, Cookeville, Tennessee*. In this work, the negative ion photoelectron spectroscopy technique is utilized to study gas-phase photodetachment of deprotonated benzonitrile ($C6H4(CN)^{-}$) isomers. Quantum mechanical calculations based on density functional theory (DFT) with 6-311++G** and aug-cc-pVQZ basis sets show the ortho, para, and meta neutral radical isomers having adiabatic electron affinity (EAs) values of 1.901, 1.778, and 1.789 eV respectively. Whereas the meta and para C6H4(CN) adiabatic EAs differ by only 0.011 eV, the ortho radical is more energetic than both the para and meta by ~0.123 eV, which is indicative of the CN inductive effect that favors deprotonation at the ortho position. The computed Franck-Condon factors obtained using the PESCAL program with harmonic frequency peak positions that are convoluted with Gaussian widths of 0.01 eV gives a C6H4(CN) vibrational structure that has several active vibrational modes: ring breathing at 1630 cm^-1, ring deformation at 632 cm^-1, and butterfly at 160 cm^-1.

1:35-1:50 Mechanism and kinetics of superoxide-mediated Hg(II) reduction. **Lesta S. Kocher* and Hong Zhang**, *Tennessee Technological University, Cookeville, Tennessee*. Kinetics of dark reduction of Hg(II) by superoxide in the presence of organic acid ligands (oxalate, citrate, cysteine) was investigated by following Hg(II) concentration changes using spectrophotometric analysis of Hg(II) with dithizone. The superoxide-mediated reduction of Hg(II) (5μM) was explored at various levels of superoxide and the ligands (0.5-5.0 mM) at low pH (3-4) and circumneutral pH (7-8). The superoxide Hg(II)-reduction at the studied levels showed similar kinetic trends to those of Hg(II) photo-reduction, where Hg(II) strongly bound to the ligand (i.e. cysteine) is not prone to reduction while the unbounded Hg(II) species (at low pH) are highly reducible. Superoxide was found to play a controlling role in the reduction as increasing levels of superoxide caused an overall larger reduction, whereas increasing levels of non-sulfur ligands did not. This kinetic and mechanistic study revealed the important role of ligands and pH in the superoxide-mediated Hg(II) reduction.

1:50-2:05 Rapid thin-layer chromatography test kit to resolve *Cannabis* plant material for law enforcement and commercial farmers. **Courtney E. LaPointe* and Jeffrey O. Boles**, *Tennessee Technological University, Cookeville, Tennessee*. *Cannabis* is defined by the United States as marijuana when there is more than 0.3% tetrahydrocannabinol, or THC, and otherwise is hemp. This differentiation of cannabinoids can only be determined at a molecular level. The current forensic presumptive testing kits only can identify the presence or absence of the genus *Cannabis* and has numerous false positives. With the development of a new rapid, thin layer chromatography presumptive testing kit, cannabinoids from plant material can be identified and then interpreted to the federal laws. Made up of a polyester backed TLC plate, a moderately polar mobile phase, and a commercial water-soluble stain, the kit is rugged and simple for law enforcement and *Cannabis* farmers to run in five to six minutes. This method differentiated between seven lots of marijuana and fifteen lots of hemp successfully by staining THC as a red color and CBD as an orange.

2:05-2:20 Shear rate effects on particle size distribution of nonliving natural organic matter. **Kathlyn N. Mealio*, Katherine E. Slamen*, Holly A. Stretz, and Martha J.M. Wells**, *Tennessee Technological University, Cookeville, TN (KM, KS, HS) and EnviroChem Services, Cookeville, TN (MW)*. Nonliving natural organic matter (NNOM) is a common material found in environmental water that presents a fouling problem in water treatment membranes. Humic acid (HA) falls under the category of NNOM and displays dynamic particle size characteristics in response to factors such as shear rate, pH, ionic strength, and temperature all of which contribute to its aggregation and disaggregation. The relationship between the aggregation time of NNOM found in pond water as a function of shear rate was investigated under constant 0.4 M CaCl2 concentrations. A rheometer was used to induce shearing of the NNOM in the range of 10 to 400 sec-1. The Particle Size Distribution (PSD) displayed a complex relationship between shear rate and relaxation behavior. Non-Newtonian behavior of the sample(s) was also explored. Preliminary data shows the disappearance of certain size ranges at specific shear rates.

2:20-2:35 Detection of biogenic amines in beer by automated dispersive liquid-liquid microextraction with fluorescence detection. **Matt Bown* and Andrew Callender**, *Tennessee Technological University, Cookeville, Tennessee*. An automated Dispersive Liquid-Liquid Microextraction with Fluorescence Detection (DLLME-FLD) method was developed for the determination of tyramine in beer samples. Tyramine was chosen as a representative primary amine, characteristic of the changes associated with beer spoilage or “wild” fermentation. The automated method was optimized over the volume and type of extraction and dispersive solvents, and the choice of derivatizing thiol. An in-house built syringe pump was used as the reaction chamber for the method. Optimum conditions were found to be pH>13, ethanol as the dispersive solvent, and octanol as the extraction solvent. Following optimization, the method limit of detection was determined to be 43 µg/L, with an enrichment factor between 87-110% and a recovery between 65-82%. The method was applied to real beer samples. This rapid and cheap method is an alternative method for the analysis of biogenic amines in beer.

2:35-2:50 Structural Basis of Docking Interactions among the Kinase Domains within ASK1-MKK-JNK3 Cascades. **Cameron W. Davis*, John M. Pleinis*, Md Sariful Islam Howlader*, Kristen N. Carter*, Thomas N. Trybala*, Derek J. Cashman, and Xuanzhi Zhan***, *Tennessee Technological University, Cookeville, Tennessee*. Mitogen-activated protein kinase (MAPK) cascades are highly conserved, three-tiered kinase pathways that orchestrate a wide array of vital cellular responses including differentiation growth, survival and apoptosis. The structural basis of these essential sign alosomes remains unclear. We aimed to explore the assembly of these three-component kinase complex with a combination of computational analyses by focusing on the complexes consisting of the kinase domains of Apoptosis activated kinase I (ASK1), its downstream MKK (MKK4 and 7) and JNK3. To achieve the putative structures of ASK1-MKKs-JNK3, we first identified the highly conserved and “frustrated” residues by conducting evolutionary trace and Frustratometer analyses, respectively. Then the kinase domains of these components were docked to each other by Cluspro. The identified interfaces were verified by direct pull-down assay experimentally. The constructed ASK1-MKK4-JNK3 structure was further analyzed by using nanoscale molecular dynamics (NAMD) and visual molecular dynamics (VMD), which showed that the complex remained stable during dynamic simulation. Such an architecture provides a mechanism of the sequential activation of MAPK by diverse stimulators and activators and demonstrates the structural insights into MAPK cascades.

2:50-3:05 A novel interactions between apoptosis signal – regulating kinase I (ASK1) and c-jun N-terminal kinases (JNK). **Sekyere Boateng* and Xuanzhi Zhan**, *Tennessee Technological University, Cookeville, Tennessee*. Mitogen – activated protein kinases (MAPKs) are a family of intracellular protein kinases that form tightly regulated signaling cascades that play important role in cell growth, differentiation and apoptosis. MAPKs are evolutionarily well conserved and function in a three-tiered kinase module where an upstream MAPK kinase kinase (MAPKKK) activates a MAPK kinase (MAPKK), which in turn activates the downstream MAPK. We recently, identified a surprising interaction between ASK1, the MAPKKK in JNK cascade, with JNK3, the downstream MAPK. This novel interaction was exploited using biochemical assays such as pull-down, SDS-PAGE, kinase assay and western blotting. We identified a novel interaction between ASK1 and JNK isoforms (JNK1/2/3). This study also identified a stronger binding affinity between ASK1 and JNK3 compared to other JNK isoforms. This led to the identification of a major ASK1 binding site in JNK3. This research looks forward to identify the biological essence of this novel interaction.

Ecology & Environmental Science and Zoology
Chairs: Dr. LaRoy Brandt & Dr. H. Dawn Wilkins
Southwest Hall 145
1:00 pm – 3:05 pm

1:00-1:05 Business Meeting

1:05-1:20 Monitoring the growth and survival of the endangered freshwater mussels *Epioblasma capsaeformis* and *Epioblasma brevidens* in the Powell River, Virginia. **Caitlin Davidson*, Alicia Gonzalez*, and Aggy Vanderpool**, *Lincoln Memorial University, Harrogate, Tennessee*. Freshwater mussels play an important role in maintaining ecosystem integrity. The Powell River, in western Virginia and eastern Tennessee is one of the last highly biodiverse river systems in North America and contains critical habitat for freshwater mussels. *Epioblasma capsaeformis* and *Epioblasma brevidens* are two federally endangered mussel species currently under restoration plans in the Powell River. In October 2019, 50 *E. capsaeformis* and 50 *E. brevidens* were PIT-tagged and stocked into two 50-meter transects at a test site in the Virginia reach of the Powell River. Mussels were also Hallprint tagged to provide unique identifiers to help recapture the mussels. Through ongoing monitoring efforts, we expect to recover no more than 30% of the mussels originally stocked in 2019. We hope to see growth rates approaching 8 millimeters per year. This study is in support of state and federal agencies to restore naturally reproducing populations.

1:20-1:35 Documenting effective pollinator species and metabarcoding environmental DNA to examine pollinator communities across the range of *Physaria globosa* (Brassicaceae). **Christopher Waters* and Shawn Krosnick**, *Tennessee Technological University, Cookeville, Tennessee*. Physaria globosa (Desv.) O'Kane & Al-Shehbaz is a federally listed species of Brassicaceae found in Tennessee, Kentucky, and Indiana. This research is part of ongoing recovery efforts to document effective pollinator species across the range of *P. globosa* and establish long-term monitoring protocols for pollinator communities via metabarcoding environmental DNA (eDNA). During floral foraging, insects leave behind fragments of DNA that can be extracted, amplified, and identified to species using barcode genes. We collected floral visitors from five populations of *P. globosa* and classified effective pollinator species. A gene sequence reference database for pollinator species was made using three mitochondrial genes. Insect eDNA was extracted from the pistils of *P. globosa* flowers for metabarcoding analysis and preliminary results had success isolating and sequencing insect eDNA from pistils. The techniques developed here could be used for long-term monitoring of *P. globosa* pollinator communities and for other rare plant species.

1:35-1:50 Mercury emission from background soils: Is the soil a source or sink for mercury? **Hong Zhang and Todd Kuiken**, *Tennessee Technological University, Cookeville, Tennessee*. Mercury (Hg) is a global pollutant (life time in air: ~6-12 months for Hg(0)). Hg (mainly Hg(0)) can emit from soils and thus Hg air/soil exchange plays an important role in global Hg cycle. Measurement of soil Hg emission has been accumulating. We had a number of measurements of the Hg emission at various sites of background soils. The data of ours and others point to an interesting finding, i.e., the soil Hg emissions are generally very low (e.g., < 3 ng m-2 h-1; in our cases, ~1 ng m-2 h-1). This raises a scientific question that has not received its due attention: Why are the soil Hg emissions so low? This presentation attempts to provide some hypothetic discussion in search of an answer to address the question. The discussion is focused on coupling of Hg air/surface cycling in its environmental transport with Hg redox cycling in its chemical transformation.

1:50-2:05 Using environmental DNA to detect the presence of Eastern Hellbenders (*Cryptobranchus alleganiensis*) in the Susquehanna River Watershed in New York State. **Ian M. Cook* and Whitney M. Kistler**, *Lincoln Memorial University, Harrogate, Tennessee*. The presence of the eastern hellbender (*Cryptobranchus alleganiensis*) in the New York section of the Susquehanna River Watershed has not been properly investigated for the last 30 years. The overall population is declining due to factors with water pollution and stream sedimentation playing a large role. Hellbenders are an environmentally sensitive species and there is sparse data regarding population estimates. Environmental DNA methods were selected as an alternative to more invasive methods of detection. Water samples were taken from 13 designated sites between June and August 2021 and then taken to the lab for further evaluation using molecular techniques. We detected the presence of hellbenders in 7 locations within the watershed. This is the first population study in this area since the 1990's. These results will be used to fill data gaps and change the understanding of the eastern hellbender in Susquehanna River Watershed of New York State.

2:05-2:20 Highly convergent species of *Anolis* lizards exhibit divergence in fundamental life-history traits. **Joshua M Hall, Christopher J Thawley, and James T Stroud**, *Tennessee Technological University, Cookeville, Tennessee (JMH), University of Rhode Island, Kingston, Rhode Island (CJT), Washington University, St. Louis, Missouri (JTS)*. Convergence is considered powerful evidence for the predictability of evolution. However, for many convergent species, it is unclear if convergence extends to relatively cryptic aspects of biology, especially those with major fitness consequences (e.g. reproductive strategies). By measuring multiple key reproductive traits across a full annual cycle, we discover divergence in life history traits in two otherwise highly convergent species of *Anolis* lizards. One species (*A. sagrei*) produces many, small eggs during a concentrated reproductive season, while the other (*A. cristatellus*) produces comparatively fewer, larger eggs over a longer period. Thus, despite being constrained to a single-egg clutch and being highly convergent in ecology and morphology, these species appear divergent in the trade-off between offspring size and number. Our results indicate that evolutionary pathways for life-history and ecomorphological traits are uncoupled in *Anolis* lizards, and there may be important variation in life-history evolution across this otherwise well-studied adaptive radiation.

2:20-2:35 River channelization effects on floodplain ecosystem structure in West Tennessee. **Lisa M. Krueger and Paula M. Gale**, *University of Tennessee at Martin, Martin, Tennessee*. Modifications, such as river channelization, are common in West Tennessee floodplains and can adversely impact ecosystem structure. Previous studies have examined local and regional effects of channelization, but few systematically examined the respective floodplain landforms as discrete units. We compared environmental and vegetative characteristics from multiple altered and unaltered floodplain sites. Soil properties, light, and species abundances were measured within twenty 1x1m understory plots and three 15x15m tree plots distributed along a 200m transect at each site. Light levels and total understory % cover were similar, but dominant understory habit class varied between sites. PCA analysis showed some separation in plots based on soil texture, soil organic matter, and nitrogen levels. Woody species composition differed between the altered vs. unaltered levee. Spoil removed from the river during channelization likely contributed to this difference. Combining soil and vegetation data will provide a clearer picture of how channelization has affected these landforms.

2:35-2:50 Evaluating wetland restoration strategies that optimize nutrient retention in agroecosystems. **Justin Murdock, Robert Brown*, Spencer Womble*, Shrijana Duwadi*, Morgan Michael* and Alfred Kalyanapu**, *Tennessee Tech University, Cookeville, Tennessee*. Agricultural watersheds contribute substantial nutrient loads into the Lower Mississippi River Basin. Channelization and levee construction that disconnects the river and floodplain, and the conversion of riparian wetlands into agricultural production greatly contribute to increased stream nutrient export. The goal of our research is to quantify nutrient retention across 40 restored riparian wetlands throughout the major river basins in western Tennessee and Kentucky. We measured nutrient retention as a function of wetland successional stage and restoration practices including hydrology and vegetation modifications. We present results from the first three years of a four-year study. Key findings include high denitrification rates across habitat types regardless of initial soil moisture, and increased retention after seven years in the program. The ecosystem services provided by these restored wetlands appears to reach beyond the creation of wildlife habitat by providing substantial water quality improvement in local and downstream agroecosystems.

2:50-3:05 Occupancy of Allegheny woodrats (*Neotoma magister*) and small mammals at rocky outcrops in Lilley Cornett Woods. **Hannah F. Blevins*, Barbara C. Shock, and Luke E. Dodd**, *Lincoln Memorial University, Harrogate, Tennessee (HB, BS), and Eastern Kentucky University, Richmond, Kentucky (LD)*. Rocky outcrops act as important habitats for various small mammal species, including Allegheny woodrats (*Neotoma magister*). Allegheny woodrat populations throughout the US have experienced declines due to factors such as habitat disturbance and fragmentation, hard mast decline, and infection with raccoon roundworm (*Baylisascaris procyonis*). This study was conducted to 1) identify rocky outcrop use by woodrats and other small mammals, 2) determine the occupancy status of Allegheny woodrats, and 3) assess the impact of disturbance on woodrat occupancy at rocky outcrops at Lilley Cornett Woods (LCW) in Letcher County, Kentucky. Woodrat occupancy was assessed via camera trapping conducted over 236 trap nights. Our results found that Allegheny woodrats were present at 61% of locations, indicating an extant Allegheny woodrat population at LCW. We found no correlation between woodrat occupancy and disturbance factors. This information will be used to update Allegheny woodrat distribution, and inform efforts to understand their population dynamics.

Engineering & Engineering Technology
Chair: Mr. Matthew Anderson
1:00 pm – 2:50 pm
Prescott Hall 325

1:00-1:05 Business Meeting

1:05-1:20 A phase-change material with a thermal switch to save energy. **David W. Yarbrough**, *R&D Services, Inc., Watertown, Tennessee*. Phase-change materials, PCMs, can reduce energy used for heating and cooling of buildings. PCMs absorb heat and then discharge it to the environment at a later time. The process of absorbing and discharging heat is controlled by temperature changes during a 24-hour period. A PCM assembly has thermal resistances (R-values) on both sides to control heat transfer rates. High R-value slows heat gain while low R-value permits rapid heat loss. An ability to change the R-value between the PCM and the exterior of a building enhances PCM savings. The R-value of a horizontal reflective air space changes as the heat-flow direction changes thus acting as a thermal switch. The thermal switch effect has been demonstrated computationally and with a field test. A discussion of the thermal-switch effect and an element of field results will be presented.

1:20-1:35 Determining the change in electrical conductivity of artificial cancer cell membranes using electrochemical impedance spectroscopy. **Khalid Tantawi, Hope Hunnicutt*, Victoria Martino*, Dottie McSpadden*** *, University of Tennessee at Chattanooga, Chattanooga, Tennessee.* The phospholipid phosphatidylserine was recently found to be the major constituent of plasma membranes of cancer cells that undergo chemotherapy. In this work, the electrical properties of phosphatidylserine were measured using electrochemical impedance spectroscopy (EIS) in the frequency range 0.01 Hz to 100 kHz. The measurements show that the resistance of phosphatidylserine is 800 kΩ and the capacitance is approximately 90 pF. These numbers are significantly less than the reported resistance and capacitance of a lipid bilayer membrane that is composed primarily of phosphatidylethanolamine, which is the major constituent in plasma membranes in normal cells. Consequently, the results show that the electrical conductivity of the membranes of cancer cells increase significantly following chemotherapy treatments.

1:35-:50 Improving the yield of biodiesel production from WVO considering the free fatty acid content and viscosity of the vegetable oil. **Saanyol I. Ityokumbul*, Stephen Idem, Daniel Swartling, Ahmed ElSawy, and Ekele A. Ogwu,** *Tennessee Technological University, Cookeville, Tennessee (SI, SI, DS, AE), and Nigerian Building and Road Research Institute, Ogun State, Nigeria (EO).* Waste vegetable oil (WVO) is an economical and environmentally benign option to produce biodiesel used to power internal combustion engines. Biodiesel from WVO is derived from the transesterification reaction of vegetable oils and alcohol at different molar ratios 4:1, 6:1, and 8:1 based on the free fatty acid distribution in the oil. The process parameters are being elucidated based on free fatty acid content while taking note of the viscosity and other physical parameters. The TTU's biodiesel processor is equipped with a Raspberry Pi 3 micro-microprocessor ultrasound UIP500 500W, 20 kHz device. The reaction time was reduced to 50 minutes from about 18 hours. A 96% yield at ratio 6:1, 0.6 wt.% concentration of catalyst (NaOH), at 6.25g and FFA% less than 5 was achieved. The conclusion reveals that biodiesel yield depends on; the nature of oil (FFA %), the degree of mixing, and the associated temperature of the reaction.

1:50-2:05 Flipped classroom for teaching CAD courses. **Mithila Rajeshirke*, Suhas Alkunte*, Ankit Gupta*, Mohammad Alshaikh Ali*, and Ismail Fidan**, *Tennessee Technological University, Cookeville, Tennessee*. Flipped Classroom model of teaching is getting popular in STEM education around the world. This unique model is built around recording lectures and labs for consumption outside of class, with classroom time devoted to discussion and more learning activities. The approach has been accepted as transformative and disruptive to STEM education. During the online instruction in Fall 2020, it was proven that this model was one of the most effective learning models in hands-on engineering and technology courses. This presentation reports the outcomes and best practices of Flipped Classroom offered in Fall 2020.

2:05-2:20 Energy conservation studies in additive manufacturing processes. **Mithila Rajeshirke*, Ranger Buchanan*, Suhas Alkunte*, Ankit Gupta*, Mohammad Alshaikh Ali*, and Ismail Fidan**, *Tennessee Technological University, Cookeville, Tennessee*. It is important to know the mechanical and quality outcomes of any additively manufactured workpiece. Lately, there are also several studies reporting the energy consumption and built time requirements of any 3D printed part. This presentation will report the energy conservation studies conducted at Tennessee Tech University for the FFF and SLA type fabricated parts.

2:20-2:35 Mobile additive manufacturing platform-development and implementation stages. **Mithila Rajeshirke*, Suhas Alkunte*, Ankit Gupta*, Mohammad Alshaikh Ali*, and Ismail Fidan**, *Tennessee Technological University, Cookeville, Tennessee*. Tennessee Tech University and Somerset Community College have developed and implemented a mobile additive manufacturing learning platform. This system contains several commonly used 3D Printers and their accessories. This presentation will report its development stages and the current outreach and educational practices of it held in the state of the Tennessee. The best practices of the system and its evaluation findings will be presented.

2:35-2:50 Machine learning and data science in additive manufacturing. **Mithila Rajeshirke*, ZhiCheng Zhang*, and Ismail Fidan**, *Tennessee Technological University, Cookeville, Tennessee*. The use of Machine Learning Techniques and its related data analytics tools has been commonly used in several prediction and classification studies lately. We have been using these techniques in inspection, quality analysis and process level classifications of the Fused Filament Fabrication processes. This presentation will report our current works at the Tennessee Tech University's Additive Manufacturing Research and Innovation Laboratory.

Geology & Geography
Chair: Dr. Michael A. Gibson
1:00 pm – 2:05 pm
Laboratory Science Commons 3122

1:00-1:05 Business Meeting

1:05-1:20 Trace fossils and a possible lycopod from the Lower Mississippian Ridgetop Shale, Hardin County, Tennessee. **Michael A. Gibson**, *University of Tennessee at Martin, Martin, Tennessee*. The Lower Mississippian Ridgetop Shale is exposed near Indian Creek, near Olive Hill in Hardin County along Highway 64. The Ridgetop exposed here is approximately 60 feet thick, consisting of buff gray fissile shale that weathers slightly tan and chippy. Fossils are generally rare, but can occur within horizons. Shelly invertebrate taxa are typically strophomenid brachiopods. Herein we describe the trace fossil fauna of the Ridgetop. One trace, as yet not assigned to a genus, dominates the ichnofauna and consists of wide (up to 4 cm), horizontal, compacted, clay-filled burrows that often show angular direction changes. The muddy infill of the burrows is distinct from the surrounding sediment and highlighted by iron-oxide burrow walls. One plant fossil that resembles the trace has been tentatively identified as belonging to the lycopod group, which if correct, is the first reported occurrence of plants from the Ridgetop Shale in Tennessee.

1:20-1:35 Trace fossils from the Hardin Sandstone, Hardin County, Tennessee. **Jack S. Garrett* and Michael A. Gibson**, *University of Tennessee at Martin, Martin, Tennessee*. The Lower Mississippian Hardin Sandstone is exposed along Highway 64 near Indian Creek and Olive Hill in Hardin County. The 15-foot thick Hardin Sandstone is the basal member of the overlying Chattanooga Black Shale. It consists of fine- to medium-grained, thin- but irregularly-bedded, pyritic-quartz sandstone with minor cross-laminations, and extensive bioturbation. Rare body fossils reported from the Hardin include conodonts, “fish”, and lingulid brachiopods; however, ichnofossils have not been described in the Hardin from this area. Herein we describe a ichnofossil-rich bioturbated horizon that includes a diverse assemblage consisting of *Nereites*?, *Arthrophycus*, *Paleophycus*, *Planolites*, *Cruziana*, and several lesser abundant ichnotaxa. This assemblage is interpreted to represent feeding traces within the shallow sublittoral mobile Hardin sand substrate being systematically mined for organics. We also report a washed-in carbonized calamite stem, which is the first record of plant fossils from the Hardin.

1:35-1:50 Water temperature variation and soil macropore habitats of headwater catchment areas near the Virgin Falls Natural Area, White County, Tennessee. **Randy M. Curtis, TN RPG #0284, Unaffiliated**, *Citizen Scientist*. The catchment of a small first order stream in the Bridgestone WMA was monitored by HOBO™ temperature loggers placed at the uppermost channel reach and various soil enclosed resurgences and sinks within two small valleys. Seasonal persistent water flow feeds the head of the stream channel via soil macropore flow. Monitors were deployed in March 2020, September 2020, and March 2021. The macropore water flow does not match the Tennessee stream classification system. From March to May 2020, the background air and water temperature median temperatures were 53.384°F and 53.994°F. The soil macropores’ median temperatures were from 53.559°F to 54.082°F. There were strong correlations between temperatures time series for the middle valley soil sink and the head of the stream, and, the middle valley slope and southern valley resurgence temperatures.

1:50-2:05 Did cyanotoxins play a role in the death of aquatic organisms in the late Cretaceous period? **Tom Byl, Michael Gibson, and Champagne Cunningham**, *U.S. Geological Survey (TB), Nashville, Tennessee, University of Tennessee, Martin, Tennessee (MG), Tennessee State University, Nashville, Tennessee (CC, TB)*. The mystery of what caused aquatic animals to die at the Coon Creek fossil site begins in the late Cretaceous period, approximately 72 million years ago, when west Tennessee was part of a warm shallow ocean. Over 400 species of preserved fossil clams, snails, crabs, lobsters, swimming reptiles such as mosasaurs, turtles, fish, plesiosaurs, and even plant fossils have been found at Coon Creek. Previous studies have shown that cyanobacteria and dinoflagellates were prevalent during this geological period. These algae can produce toxins that cause red tides and harmful algal blooms. The objective of this project will be to determine if cyanotoxins are present in the soils, fossil shells and sediments, possibly contributing to the demise of 5 air-breathing reptiles found near each other. The sediments will be tested for saxitoxin and microcystin.

Health & Medical Sciences
Chair: Dr. Aliyar Fouladkhah
1:00 pm – 1:50 pm
Laboratory Science Commons 1207

1:00-1:05 Business Meeting

1:05-1:20 A pan-serotype pathway implicated in *Streptococcus pneumoniae* invasion of blood-brain barrier. **Chengxian Zhang, Ningyu Zhu, Atish Prakash, Donna Pearce, Zheng Hou, Wei Liu, Weifeng She, Adam Sapirstein, Andrew Morris, Yoshihide Kanaoka, Brendan Cormack, and Kwang Kim**, *Austin Peay State University, Clarksville, Tennessee (CZ), Johns Hopkins University School of Medicine, Baltimore, MD (CZ, NZ, AP, DP, ZH, WL, WS, AS, BC, KK), University of Kentucky, Lexington, KY (AM), The Brigham and Women's Hospital, Boston, MA (YK)*. *Streptococcus pneumoniae* remains the leading cause of bacterial meningitis, and pneumococcal meningitis continues to be an important cause of mortality and morbidity. The introduction of pneumococcal conjugate vaccines has been efficacious in the reduction of meningitis caused by vaccine serotypes, but the emergence of non-vaccine serotypes presents a challenge. In this study, we characterized in detail how *S. pneumoniae* penetrates the blood-brain barrier and showed that it exploits a network of specific host factors (EGFR, CysLT1) resulting in uptake by brain endothelial cells. This network of host factors impacts penetration into the brain for both vaccine and non-vaccine serotypes. Our findings uncover a novel pathway important in pneumococcal penetration of the blood-brain barrier, which is of potential use as a therapeutic target for pneumococcal meningitis.

1:20-1:35 Public health significance of wild-type and rifampicin-resistant Shiga toxin-producing *Escherichia coli*. **Sabrina Wadood and Aliyar Cyrus Fouladkhah***, *Public Health Microbiology Laboratory, Tennessee State University, Nashville, Tennessee*. Various epidemiologically significant serogroups of Shiga toxin-producing *Escherichia coli* continue to be important concerns in primary and further processing of an array of commodities and particularly meat products. Current study investigated effects of sodium hypochlorite, 5% lactic acid, and quaternary ammonium compounds against planktonic cells and biofilms of wild-type and rifampicin-resistant Shiga toxin-producing *Escherichia coli* on stainless steel coupons. Our results indicate that the tested sanitizers are efficacious to eliminate the pathogen at planktonic state while exhibiting low decontamination efficacy against sessile cells. Additionally, we observed that wild-type and rifampicin-resistant phenotypes of Shiga toxin-producing *Escherichia coli* have comparable biofilm formation capability and sensitivity to sanitizers and thus could be used interchangeably in microbiological hurdle validation studies.

1:35-1:50 Thymol as a bioactive compound to enhance pressure-based inactivation of Shiga toxigenic *E. coli.* **Sadiye Aras, Shahid Chowdhury, and Aliyar Fouladkhah**, *Public Health Microbiology Laboratory, Tennessee State University, Nashville, Tennessee*. Current study investigated inactivation of *Escherichia coli* O157:H7 using mild heat, hydrostatic pressure, and thymol in meat homogenate. Six-strain mixture of *Escherichia coli* O157:H7 were exposed to 0 to 9 minutes of six treatments: i) hydrostatic pressure at 4 ºC; ii) hydrostatic pressure and thymol at 4 ºC; iii) thymol at 4 ºC; iv) heat at 40 ºC; v) hydrostatic pressure at 40 ºC; vi) hydrostatic pressure and thymol at 40 ºC. Pressure intensity level of 400 MPa and thymol concentration of 0.15% were used for the experiments of inoculated pathogen in sterilized 10% meat homogenate. Results of the current study could be adapted by stakeholders of pressure-treated products for meeting the regulatory requirements such as the Hazard Analysis and Critical Control Point and Preventive Controls for Human Food rule of FSMA for reducing the public health burden of Shiga toxin-producing *Escherichia coli* O157:H7.

History of Science

Chair: Dr. Soma Banerjee
1:00 pm – 1:05 pm
Laboratory Science Commons 1307

1:00-1:05 Business Meeting
No presentations are scheduled in this section for this meeting

Math and Computer Science
Chair: Dr. Daniel Mayo
1:00 pm – 2:35 pm
Laboratory Science Commons 1211

1:00-2:05 Business Meeting

1:05-1:20 Some thoughts on goalkeeping and goalscoring in soccer. **Arjun Tan**, *Alabama A & M University, Normal, Alabama*. Some aspects of goalkeeping and goalscoring in Soccer are discussed. For goalkeeping, the taller goalkeeper has a natural advantage to deal with the high balls. However, the shorter goalkeeper can fall a fraction of a second quicker and is better able to clear low balls. As for goalscoring from a close range, the solid angles subtended by the goal area at the strike location is taken as a measure of effectiveness of a strike. The solid angles are calculated for ground kicks, aerial kicks and headers. The aerial kicks and headers have greater solid angles than the more common ground kicks and are therefore more likely to score from a geometrical point of view. Further, it is more difficult for the goalkeeper to predict the strike location of a header or an aerial kick and the subsequent direction of the ball, which makes that strike an even more dangerous one.

1:20-1:35 The Holy Trinity of West Indies Cricket: Separating the inseparables. **Arjun Tan**, *Alabama A & M University, Normal, Alabama*. The 'Three Ws of West Indian cricket' of Frank Worrell, Everton Weekes and Clyde Walcott have now been relabeled as the 'Holy Trinity of West Indies cricket'. The batting careers and batting statistics of the Three Ws were uncannily similar. The resemblance coefficients between the Three Ws for both qualitative and quantitative attributes ranged from the upper 80s to 100 percent. The probability that the Three Ws were all born in Barbados and had surnames beginning with W was estimated as 7.41 in a million! Most writers had refrained from ranking the Three Ws because they were 'inseparable' and doing that was 'unthinkable' and even 'sinful', whilst in public debate raged and continues today as to who was the greatest batsman amongst them. This study proposes a scheme to accomplish the latter. The result is a photo-finish with Weekes in first place followed by Worrell and Walcott in that order.

1:35-1:50 Severe precipitation events and their effects on waterborne illnesses. **Laina Skaggs* and Ramanjit Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Climate change is expected to increase the amount of waterborne Acute Gastrointestinal infections (AGI) incidents globally. This is due in most part to more intense and frequent precipitation resulting from the changes in climate. Extreme precipitation may transfer pathogens from reservoirs (such as animal manure) into surface water either by increasing the runoff from land to water, or more directly by increasing the turbidity which increases the re-suspension of infectious particles. Statistical analysis is applied on historical data to predict the relationship between climate change's effects on severe rain patterns and AGI's. It is observed that increase in precipitation causes AGI incidents to increase. Thus, there is evidence that climate changes have an impact on waterborne diseases.

1:50-2:05 Pros and cons of California land preservation. **Madisson A. Russell* and Ramanjit Sahi**, *Austin Peay State University, Clarksville, Tennessee*. Land preservation has many benefits for the environment, but these benefits can be difficult to quantify. One way to encourage the continued preservation of land is to show the owners that there is a financial benefit of doing so. To justify land preservation, public records of national parks visitation rates were used to calculate the value of non-timber benefits or the critical amenity value. Using regression, it can be confirmed that the visitation data is consistent with Geometric Brownian Motion, which means it can be used to estimate the mean and standard deviation. Then, the discount rate is applied and tested with the mean. It is noted that critical amenity value will be zero or negative, if the discount rate is less than or equal to the mean. This indicates that it would be financially beneficial to continue to preserve the land.

2:05-2:20 Pricing an option strategy using the binomial option pricing model. **Yufenyuy Sevidzem Simo***, *Austin Peay State University, Clarksville, Tennessee*. The purpose of this presentation is to explain the process of pricing an option strategy, be it a Call or Put Option (American or European) considering factors such as volatility, dividend, interest rates, stock price and strike price. My objective is to explain what an option strategy is, the different types of option strategies, how they work and their application. This will permit better decisions on the stock market and know if the price we are getting is fair enough for both the buyer and seller. The results obtained will be from solving an example of both the call and put scenarios for the European and American option strategies. From the results, we may then be able to conclude that the price of an American put option may sometimes be higher than that of a European put or call because of the opportunity to exercise before the expiration date.

2:20-2:35 Developing a fish image classification system for Mouse Creek, Cleveland, TN using machine learning. **Rishi Soni***, *Cleveland High School, Cleveland, Tennessee*. The classification of fish through visual inspection can often be a time-consuming and fallible process, and thus, there is a necessity for a fish classification method with greater accuracy and efficiency. Therefore, this study aimed to develop a fish image classification system for 16 species of fish found in Mouse Creek, Cleveland, TN using machine learning. An initial dataset of 189 high-quality images was expanded using data augmentation and modified with color preprocessing, producing a diverse dataset of 1512 images. Multiple machine learning algorithms were tested using random 80/20 splits of the dataset after Wolfram language built-in feature extraction was performed. Ultimately, this study achieved a machine learning model based on SVM classification that can classify 16 species of fish nearly instantaneously with 99.01% accuracy. This model strongly outperforms alternative image classification tools, making it one of the only effective freshwater fish classification systems for urban stream settings.

Microbiology
Chair: Dr. Sergei Markov
1:00 pm – 1:35 pm
Virtual Session—Please see website for Zoom link
Laboratory Science Commons 3331

1:00-1:05 Business Meeting

1:05-1:20 The presence of tRNA genes in A1 subcluster Mycobacteriophages. **Adrianna Sasser*, Alissa Williams, Annaleisa Matzirakis, Wilson Myers, and Elvira Eivazova**, *Columbia State Community College, Columbia, Tennessee*. The goal of this study was to annotate and characterize the Mycobacteria phage Dussy belonging to the A1 subcluster of A cluster phages. Phage Dussy utilizes the temperate life cycle by integrating its DNA into the bacterial host as a prophage. In contrast, lytic phages replicate in the host's cytoplasm independently from the genome of the host. The annotation of phage Dussy showed that its genome of 89 genes carries one tRNA gene. The presence of tRNA gene was confirmed by Aragorn and tRNA-Scan analysis software. Frequencies of tRNA genes were then evaluated in both the temperate and lytic phage genomes of the A1 subcluster and the A cluster. We conclude that tRNA genes are more prevalent in lytic, rather than temperate phages, likely due to the fact that lytic phage DNA is not incorporated into the bacterial genome and relies on its own tRNA genes for translation.

1:20-1:35 Citric Acid/β-Alanine Carbon Dots as a novel antimicrobial agent against Gram-Negative Bacteria. **Anju Pandey*, Asmita Devkota, Zeinab Yadegari, Korsi Dumenyo and Ali Taheri**, *Tennessee State University, Nashville, Tennessee (AP,AD, KS, AT) and Fisk University, Nashville, Tennessee (ZY)*. Multi-drug resistance in bacteria is an emerging public health concern. Carbon dots (CDs) are considered as new source of antimicrobial agents. In this study, we prepared carbon dots from citric acid and β-alanine and evaluated their antimicrobial properties against a diverse group of Gram-negative bacteria, including *E. coli*, *Salmonella*, Pseudomonas, *Agrobacterium*, and *Pectobacterium* species. The antibacterial activity of these CDs was studied using well-diffusion method with different concentrations of CDs ranging from 0.5 to 10 mg/mL. Our findings indicate that these CDs can be an effective alternative to commercially available antibiotics. We also demonstrated the minimum incubation time required for complete inhibition of bacterial growth, which varied depending on bacterial species. With 5 h incubation time, *Agrobacterium* and *Pseudomonas* were the most sensitive strains, whereas *E. coli* and *Salmonella* were the most resistant bacterial strains requiring over 11 h incubation with CDs.

Physics & Astronomy
Chair: Dr. Robert Pattie
1:00 pm – 2:35 pm
Ray Morris Hall STEM Center 137

1:00-1:05 Business Meeting

1:05-1:20 Magnetic microsphere disk hopping behavior: simulation and experiment. **Gregory Vieira, Eliza Howard, Chris Hoang, and Ryan Simms**, *Rhodes College, Memphis, Tennessee*. Magnetic microspheres are commercially-available, fluid-borne particles made of iron oxide encapsulated in polystyrene. Whereas the microspheres experience forces in magnetic field gradients and can be specifically bound to biological targets, they are designed for bioseparation of cells, proteins, DNA, and RNA. Recent work has been done in the development of surface-based transport schemes and means of applying magnetic forces, showing promise for use in on-chip devices. We investigate particle motion on one such architecture, arrays of permalloy disks, aided by application of time-varying magnetic fields. I will discuss both long-range (100s of micrometer) and short range (<10 micrometer) microsphere transport on disk arrays. Furthermore, I will show comparison between computer models which simulate transport and the observed behavior. Our model predicts limitations to particle speed due to phase-slipping motion, describes how transport depends on particle size, and suggests a means for estimating low-field magnetic susceptibilities of individual particles.

1:20-1:35 Neutron inelastic scattering of 76Ge coincidence analysis. **Kaitlyn E. Kidwell*, M. F. Kidd, W. Tornow, and S. W. Finch**, *Tennessee Technological University, Cookeville, Tennessee (KK, MK), and Duke University/Triangular Universities Nuclear Lab, Durham, North Carolina (WT,SF)*. In the study of neutrinoless double beta decay of 76Ge, the potential background events need to be fully understood. One potential background comes from neutrons, specifically neutron inelastic scattering. The de-excitation of the 76Ge nucleus could produce gamma rays in the double beta decay region of interest at 2039.061 keV. Camp and Foster first measured an excited level in 76Ge with an energy of 3951 keV, which de-excites with the emission of a 2040.70 keV gamma ray. In a 2015 study by Crider et al., they investigated neutron inelastic scattering on 76Ge with 3.7 MeV neutrons. They did not observe the 2040 keV gamma ray, and instead, they placed a level at 3147 keV and observed a 2038 keV gamma ray emission. We have extended this neutron inelastic scattering measurement to 4.5 MeV incoming neutrons at Triangle Universities Nuclear Laboratory (TUNL). In our current study, we investigate the production of the 3147 keV level by creating coincidence spectra at 2038 keV - 1108 keV, 2041 keV - 1911 keV, 2583 keV - 562 keV, and 2579 keV - 562 keV.

1:35-1:50 Star cluster local standard solutions. **J. Allyn Smith, Douglas L. Tucker, Sahar S. Allam, Elizabeth J. Jeffery, and Jamin E. Welch**, *Austin Peay State University, Clarksville, Tennessee (JAS), Fermilab, Batavia, Illinois (DLT, SSA), California Polytechnic State University, San Luis Obispo, California (EJJ), and Unaffiliated (JEW).* We present standardized solutions for the open star cluster Dolidze-35 based on four years of observational data. These data from ~1600 stars include several which are useful as local secondary standards and some which are variable stars. We also discuss an initial set of local standard stars in the field of NGC-6253 developed to support Gemini observations.

1:50-2:05 Atmospheric extinction – what is good enough? **Vincent Wriston*, J. Allyn Smith, Douglas L. Tucker, Sahar S. Allam, Melissa J. Butner, and Jamin E. Welch**, *Austin Peay State University, Clarksville, Tennessee (VW, JAS), Fermilab, Batavia, Illinois (DLT, SSA), East Tennessee State University, Johnson City, Tennessee (MJB), Unaffiliated, Nashville, Tennessee (JEW)*. What is the best technique for calculating atmospheric extinction coefficients? Often, the best fit to the grey atmosphere is a trade-off between rejection of outlier stars in the solution and a loose fit to ensure enough stars remain for a robust solution. We explore several nights of data and explore the effects of a robust sigma clipping routine to derive five filter (SDSS-*ugriz*) extinction coefficients. Our data are developed using an iterative sigma clipping fitting routine as we look at the effects of the clipping factor and number of iterations and compare the final fits and the number of remaining stars. These are compared to the residuals in the standard stars used for the fit. The fitting routine, pyExcal, is an outgrowth of the SDSS mtpipe software suite.

2:05-2:20 Light variability in proto-planetary nebulae. **Gary D. Henson, Bruce J. Hrivnak, Todd C. Hillwig, and Wenxian Lu,** *East Tennessee State University, Johnson City, Tennessee (GH), and Valparaiso University, Valparaiso, Indiana (BH, TH, WL).* We present the results from long-term studies of post-asymptotic giant branch (post-AGB) stars, more specifically, objects that appear to be in transition from the AGB to the planetary nebula phases, so called proto-planetary nebulae (PPNe). Light variations have been monitored for a large sample of such objects for nearly two decades. Light curves were produced and analyzed for periodic variability. Several suspected pulsation periods were found, typically multiple periods for a given object suggesting non-radial or semi-regular pulsation behavior. The dominant trend is one of shorter period and smaller amplitude with higher temperature. A few objects were found to possess long-period variations on the order of several years suggesting the presence of a binary companion and possible circumbinary disk interactions. Supplemental spectroscopy and the spectral energy distribution were used to confirm the identification of the objects as to their evolutionary status between the asymptotic giant branch and planetary nebulae stages.

2:20-2:35 Silicon photomultiplier detector development for the UCNA+ experiment, **R.W. Pattie Jr and R.M McDonald IV**, *East Tennessee State University, Johnson City, Tennessee*. Beta-decay angular correlation coefficients are to, leading order, given by lambda, the ratio of the axial-vector and vector coupling constants. Combining measurements of the neutron lifetime and the correlation coefficients allows for precision tests of the standard model. The UCNA experiment at the Los Alamos ultracold neutron source measured the beta-asymmetry coefficient A to a precision of 0.6% using a 2x2p magnetic spectrometer, limited by electron scattering systematics and low UCN density. UCNA+ will replace the multiwire proportional count and plastic scintillator detection system with a 16- sided plastic scintillator with edge coupled silicon photomultiplier readout to minimize scattering systematics and take advantage of upgrades to LANL UCN source to increase the UCN density by a factor of approximately 6. I will present details of detector upgrades and the path towards a 0.2% determination of A.

Science and Math Teaching
Chair: Dr. Philip Short
1:00 pm – 2:35 pm
Ray Morris Hall STEM Center 139

1:00-1:05 Business Meeting

1:05-1:20 Inquiring minds would like to know: assessing the impact of inquiry-based teaching in a university introductory biology course. **Brittany McGuire*, Shawn Zeringue-Krosnick, Kelly Moore, and Aubree Hill**, *Tennessee Technological University, Cookeville, Tennessee*. Introductory biology courses are foundational experiences for first-year students. In particular, laboratories provide opportunities for students to make meaningful connections with course material and learn essential skills as future scientists. However, these labs are often taught via demonstrations and activities planned to ensure specific conclusions. Transitioning introductory labs to an inquiry-based model may be a more engaging environment for students to apply their knowledge and skills that more accurately reflects real-world scientific research. The goal of this study is to compare the effect of inquiry-based teaching approaches versus traditional teaching methods with respect to (1) student understanding of experimental design and (2) content knowledge. In fall 2021, students in half of the BIOL 1113 lab sections (n = 101) at Tennessee Tech University (Cookeville) participated in an alternative inquiry-based activity in place of the traditional demonstration-based activity for one topic. Results from this study are forthcoming and will be discussed.

1:20-1:35 Positive carryover effects of self-regulated learning on exam grades in college biology and anatomy & physiology classes. **Taylor Burress*, Donald Shaw, and Morgan A. Robertson**, *University of Tennessee at Martin, Martin, Tennessee*. The purpose of this study was to analyze the effects of an adoption of a two-week SRL (self-regulated learning) in college science classes. Students who participated in SRL kept a study journal for a two-week period until right before the date of Examinations 1 and/or 2, respectively. The effectiveness of the self-regulated learning process was evaluated based on their performance of the unit exams. Students' perception of the SRL process was completed by an anonymous survey. We found students in the SRL group achieved higher exam scores compared to the non SRL- group for five out of the seven times when SRL was offered. We also found in human anatomy and physiology class on exam #4 that a positive carryover effect occurred between SRL and non-SRL groups. In conclusion, SRL positively affects the grades of students' exam scores, particularly students who are taking the class for their major.

1:35-1:50 Game development and instructional design for open educational resources in computer science. **Saeid Samadidana, Michael J. Wilson, and Ellen C. Brown**, *Austin Peay State University, Clarksville, Tennessee*. Faculty at Austin Peay State University have noticed a decline in student enrollment and student diversity between the first and second semester of introductory computer science courses as a result of elevated failure and withdrawal rates. Institutional data from spring, summer, and fall of 2020, indicate a student completion rate of 69.5% (n=296) for the first semester introductory computer science course (CSCI 1010). Therefore, it is within these gateway courses that deficiencies exist and where the development of dynamic open educational learning materials could impact student success rates. Multi-sensorial and active learning opportunities support the acquisition of foundational problem-solving skills needed to advance within introductory courses and beyond. Using the combined understanding of game development and instructional design, this project aims to maximize the success of APSU’s diverse student body in computer science gateway courses. Current results focus on instructional design for open educational resources (OER) development in computer science.

1:50-2:05 Perceptions of eTextbook platform experiences: Development of a student survey. **Terra L. Smith and Loveday E. Nwobilor**, *The University of Memphis, Memphis, and Tennessee and Shelby Residential and Vocational Services, Memphis, Tennessee*. As textbook publishers search for sustainable business models, students are caught in tides of changes that have created eTextbook platforms. The purpose of the proposed survey is to help faculty understand the experiences of introduction-to-nutrition students engaging learning through the medium of a learning-management-system-nested eTextbook platform. The proposed survey addresses 3 key faculty concerns: First, to confirm that the developmental stage of the students is emerging adult. Second, to determine how the task of engaging an eTextbook platform learning delivery system impacts the self-perceived cognitive load of students. Third, to document the self-perceived impact on students' habits and practices while interacting with an eTextbook platform. That is, to explore how an eTextbook platform impacts students' physical interactions with learning materials. Once constructed and implemented, the survey will help faculty better understand the support needed by introduction-to-nutrition students learning within a nested learning eTextbook platform.

2:05-2:20 Urban youth agricultural literacy impacts of an educational experience with the Tennessee State University mobile agriculture classroom and lab. **Jenna Jones*, John C. Ricketts, and Thomas Broyles**, *Tennessee State University, Nashville, Tennessee*. Lack of agricultural education has greatly reduced agriculture literacy among urban populations. To mitigate this problem, we developed lesson plans on agricultural literacy via the TSU mobile classroom and shared experiences with middle schools in Metro Nashville Public Schools. We examined 70 middle school students' perceptions and knowledge of agriculture as a result of the mobile classroom with a pre-test and posttest. The TSU mobile classroom experience included informative videos, engaging music, and hands-on lessons with a focus on the relationship between agriculture and animals. The experience had a positive impact on agricultural knowledge and perceptions of the relationship between agriculture and animals. Students also had a positive perception of the TSU mobile classroom and Tennessee State University. Recommendations include program improvement and expansion with additional experiences for youth in other areas of agriculture and continuation of the middle school partnerships to ensure agricultural education is accessible to urban youth.

2:20-2:35 Scientist spotlights and quantitative analyses. **Darlene Panvini**, *Belmont University, Nashville, Tennessee*. As student populations become more diverse, incorporating a variety of scientist perspectives and voices in STEM courses can both promote student learning and enhance science identity. Implementing "Scientist Spotlights" provides an opportunity for students to identify with scientists from diverse backgrounds. Coupling this with an activity to analyze data and/or graphs from the scientists' research can build students' quantitative skills. However, the time for faculty to find and develop these resources can seem daunting. This session will describe resources available to faculty interested in incorporating scientist spotlights and quantitative analyses into their courses and provide some tips for facilitating this process. Examples from introductory and upper-level biology courses will be included. The session will also introduce faculty to the benefits of participating in a faculty mentoring network and the open educational resources (OERs) at Qubes.

Poster Presentations
Laboratory Science Commons Main Hallway

Agriculture Posters

1-01 Implementation of supplemental instruction in Applied Animal Reproduction course. ***Diana Watson, Montana Wright*, Danny Walker, and Jason Roberts***, *University of Tennessee at Martin, Martin, Tennessee*. The objective of this project was to enhance student comprehension and retention of animal reproduction concepts and to allow students the opportunity to explore teaching by functioning as a supplemental instructor. Specific outcomes included student understanding of the anatomy, endocrinology and related processes of reproduction to facilitate the ability to manipulate and apply that information in real world situations and advanced reproductive techniques. The use of supplemental instruction increased contact between students and the material resulting in better outcomes for those who participated. The student instructor also developed increased knowledge and training in appropriate teaching paradigms. Tracking of student participation, evaluation of the supplemental instruction experience, and overall grade averages will be observed to determine the success of this program.

1-02 Redevelopment of interpersonal skills among science related majors in agriculture. ***Diana Watson, Sandy Mehlhorn, and Joey Mehlhorn***, *University of Tennessee at Martin, Martin, Tennessee*. Universities are well equipped to develop technical and science related skills for undergraduates through rigorous coursework and laboratory experiences. Students training in traditional areas of the agricultural sciences tend to discount the importance of developing interpersonal skills that will be needed in the professional world. The University of Tennessee at Martin started a Delta Tau Alpha Agricultural Honor Society with the purpose of helping students develop these skills. Covid restrictions have decreased face-to-face interactions and hampered success in developing networking opportunities, however, the group has been able to increase interactions among the various agricultural students and faculty. This project will share student and faculty reflections on developing teamwork, leadership, communication, and interpersonal skills among students through targeted activities. Student organizations are essential in providing opportunities for face-to-face interactions and communications skills that are crucial for success in the professional world.

1-03 Gaging student growth in veterinary knowledge. ***Danny Walker, Zach Morphis, and Amanda Waldon***, *University of Tennessee at Martin, Martin, Tennessee*. Today, the competitive nature of being accepted into a College of Veterinary Medicine (CVM) is driving many students to start their academic training well before entering college. Experiences like the Tennessee Governor's School for the Agricultural Sciences (TGSAS) can be a valuable educational experience for participants. In 2021, TGSAS participants engaged in a veterinary science study project were pre and post tested to assess the effectiveness of knowledge gain. Veterinary topics included small animal, large animal, specialty, research, and shelter medicine. Students completed directed educational activities focused on specific content and then were post tested at the conclusion. Results indicated that overall students' knowledge improved by 12%; however, no student received a perfect score. While the overall goal of improvement was met, it was surprising that mastery was not attained. As a result, experiential activities will be reassessed for future classes to improve student knowledge retention.

1-04 Protecting man's best friend through monitoring parasites in dog parks. ***Danny Walker, Kelly Garner, and Amanda Waldon***, *University of Tennessee at Martin, Martin, Tennessee*. Pet health has grown into a large industry in the U.S. with pet owners spending approximately $100 billion on pet care annually. It is important for communities to work to ensure that areas with large concentrations of pets and people have limited exposure to disease and parasites. Developing a baseline for parasite levels is an important first step in creating safe environments for pets. This study collected fecal samples over a two-week period and conducted microscopic analysis using a fecasol solution. Results indicated 7 out of the 50 samples were positive for intestinal parasites. That equates to around 14% compared to the national average of 20%. The findings indicated that parasite pressure is below the national average, but efforts can be made to reduce the number. The importance of this type of research is that parasite control impacts pet health and can even affect the humans in that household.

1-05 Environmental temperature effects on milk production and daily activity in dairy cows with respect to different breeds. ***Ashton C. Bazzell* and Jessica G. Carter***, *Middle Tennessee State University, Murfreesboro, Tennessee*. Heat stress is an animal's response to an increase in thermal environment that causes them to inadequately dissipate heat out of the body and leads to decreased milk production. The objective of this project was to determine the most desirable temperature and humidity range that results in normal activity and optimum daily milk production in a lactating dairy herd. Cow production (milk yield and conductivity) and activity data (steps, rest bouts, and rest time) were collected over three seasons (winter, spring, and summer). Daily temperature and relative humidity were collected during each season to determine the effects of the environment on milk production, conductivity, and cow activity. The hypothesis is that as ambient temperature and daily humidity increases, milk yield will decrease due to the effects of heat stress on the cow. Results will be presented after data analysis using a mixed model procedure in SAS.

1-06 Tennessee growers' knowledge and perception of IPM: A survey result from a case study. ***Kaushalya G. Amarasekare, Aditya R. Khanal, and Christian Smith****, *Tennessee State University, Nashville, Tennessee*. Integrated pest management (IPM) is an environmentally sustainable arthropod pest suppression technique. Biological control, one of the critical components of IPM, helps manage arthropod pests with less or no use of harmful pesticides. However, growers may have limited knowledge and understanding of IPM. We designed a comprehensive questionnaire and administered an electronic survey to assess the knowledge, perception, and experience of IPM of Tennessee specialty crop growers. We used a grower database and Tennessee Cooperative Extension Program to disseminate this survey. Results show that 53% and 61% of sampled-growers had a below-average or average knowledge on IPM and biological control, respectively. Approximately 39% of the growers have taken some course related to IPM, and 63% of them got training provided by Extension Agents and/or Specialists. Our study highlights the scope and importance of Extension training for growers to adopt IPM. We discuss the results of various components of IPM.

1-07 Allelopathic effects of winter cover crop species annual ryegrass and crimson clover on different test species. ***Grayson DeLay* and Anthony Witcher***, *Tennessee State University, McMinnville, Tennessee*. Winter cover crops are used in crop production systems for multiple benefits including weed suppression and increased pollinator habitat. Some cover crops contain allelopathic chemicals inhibitory to weed germination and root growth but response varies by cover crop and weed species. The study evaluated aqueous extracts of dried shoots (100g/L, 75g/L, 50g/L, 25g/L, and 0g/L as control) from annual ryegrass and crimson clover on germination and root length of annual ryegrass, lettuce, onion, and tomato. Seeds were placed on extract saturated filter paper in petri dishes for 7 days. Annual ryegrass extract (all concentrations) decreased germination of all species. Crimson clover extract (100g/L) reduced germination of all species, but 25g/L only reduced lettuce germination. All species had decreased root length with both extracts except annual ryegrass at 25g/L crimson clover extract. These results can be used in future studies to determine the minimum extract amount to inhibit weed seed germination.

1-08 Effects of solitary and combined use of cover crops on soilborne disease suppressiveness in woody ornamental nursery production systems. ***Madhav Parajuli*, Milan Pant*, and Fulya Baysal-Gurel***, *Tennessee State University, McMinnville, Tennessee (MP, FBG), and Clemson University, Blackville, South Carolina (MP)*. We explored the impacts of cover crops, in solitary and combined use, on soilborne disease suppressiveness in woody ornamental nursery production systems. Soils were sampled from the established red maple (*Acer rubrum* L.) plantation grown with and without cover crops [crimson clover (*Trifolium incarnatum* L.) or triticale (× Triticosecale W.) or (their mixture)] following the cover crop senescence. Greenhouse bioassays were carried out using red maple cuttings on inoculated (with *Rhizoctonia solani*, *Phytopythium vexans*, or *Phytophthora nicotianae*) and non-inoculated field soils. Total plant and fresh root weights were greater for red maple plants grown in cover cropped soil. Although all the cover crop treatments demonstrated effective control of root rot diseases, a high rate of crimson clover and the mixture were the most effective. There were no significant differences in plant height among the treatments. These findings may be helpful to nursery growers in making soilborne disease management decisions.

1-09 Cover crops and their relationship to soil moisture and infiltration. ***Mason Chandler*, Sandy Mehlhorn, and Bethany Wolters***, *University of Tennessee at Martin, Martin, Tennessee*. Cover cropping has been a growing discussion in the agricultural world for many years now. Cover cropping proponents claim many benefits, including increased soil infiltration and longer lasting soil moisture. This research compares the difference in soil infiltration and moisture content in spring planted corn fields that had cover crops to fields that did not. All of the fields' producers use no-till practices. Precisionking, Hoboware, and Aqua Trac sensors (n=15) were used to record soil moisture data, while an infiltrometer was used to determine soil infiltration. Precisionking sensors measure soil pressure as the moisture enters and leaves the soil. The Hoboware and Aqua Trac units monitor volumetric water content in the soil. Data from the sensors was used to measure the moisture of the soil at various depths versus time for two hours before and after a rain or irrigation, then compared to soil infiltration data.

1-10 Evaluation of fungicides for the control of powdery mildew and spot anthracnose of dogwood. ***Christina S. Jennings*, Terri Simmons, and Fulya Baysal-Gurel***, *Tennessee State University, Nashville, Tennessee*. Powdery mildew and spot anthracnose disease are important diseases of dogwood in nursery production. The efficacy of fungicides against powdery mildew and spot anthracnose were assessed on dogwood 'Cherokee Princess.' Treatments were Eagle 20 EW, Pageant, Mural and Kleengrow. Powdery mildew and spot anthracnose severity were determined by the percentage of foliage affected. All treatments significantly reduced disease severity and disease progress (AUDPC) compared to the non-treated control plants. All treatments were similar in both the control of powdery mildew and spot anthracnose disease severity and AUDPC.

1-11 Volatile distribution and profiles of ginger by electronic nose. ***Ramasamy Ravi*, Sunil1, and Dharma Pitchay***, *Tennessee State University, Nashville, Tennessee*. Ginger (*Zingiber officinale*) rich in aromatic volatiles, widely used in traditional medicine due to its various health-promoting properties. This study was carried out to explore and quantify the distribution of various natural volatiles present in young, recently matured, matured and old leaves of ginger using an electronic nose. Different varieties of ginger (Chinese origin) were analyzed and concentration of aromatic volatiles were quantified. Young, recently matured, matured and old leaves of ginger showed major volatiles like benzaldehyde, 1, 8- cineole, myrcene, butane-2, 3-dione, 1 S-α- pinene, Z-3-Hexen-1-ol acetate, butanol and 1-Propanal, 2-methyl- volatiles were identified. A significant variation in the composition, quantity and distribution of volatiles was found. The distribution of aromatic volatiles in this study would provide better insight and guidance to the consumers for maximum utilization ginger plant tissues beside rhizome and contribute to the sustainability of ginger production and marketing.

1-12 Soil and agricultural water (pre-harvesting factors) interfering with the quality of leafy green vegetables: challenges & solutions. ***Ukti B. Sheth*, Tony V. Johnston, and Seockmo Ku***, *Middle Tennessee State University, Murfreesboro, Tennessee*. The term "health is wealth" has gained attention as consumers choose health over taste by selecting leafy greens. Consumers prefer consuming leafy greens such as lettuce, spinach, kale as raw/minimally processed. Any minor loophole can jeopardize the quality and expose it to a major foodborne illness outbreak. Thus, it is crucial to maintain its quality right from the field itself to prevent the exposure of pathogenic strains from the soil, water, and other components (coming in contact with edible greens). Pathogens like *Escherichia Coli*, *Salmonella*, *Norovirus*, *Listeria*, by internalization and biofilm formation, interfere with leafy greens quality and pose a public health hazard. The two vehicles behind the deteriorating quality of greens are soil and water used in irrigation/agriculture. Proper selection of water source, disinfection chemical, Best Management Practices, and Good Manufacturing Practices can reduce health risk while preserving the quality of leafy greens.

Botany Posters

2-01 The effect of sulfide-rich water on hemp seedling growth. **Baron Hill*, Tom Byl, Emmanuel Omondi, and De'Etra Young**, *Tennessee State University, Nashville, Tennessee (BH, TB, EO, DY), U.S. Geological Survey, Nashville, Tennessee (TB)*. Previous research found water enriched in sulfide stimulated plant growth. This study's objective was to determine if groundwater from Tennessee State University's farm well naturally rich in sulfide stimulated hemp growth. *Cannibas sativa*, variety Henola, were raised in the lab under constant light and temperature using waters containing high sulfide (65-105 mg/L) or no sulfide. The sulfide-rich treatment was compared to plants raised using the same water treated with hydrogen peroxide to oxidize the sulfide to sulfate. Ten days after planting, hemp raised in sulfide-rich waters were significantly taller (average 3 cm) as compared to seedlings raised in oxidized waters (2 cm tall, $p = 0.01$). Additional shoot, root, body weight and enzyme levels will be measured to determine if sulfide enhances hemp production.

2-02 Adaptations of the stylet sheath among plant vascular tissue feeding insects, *Clastoptera xanthocephala* and *Aphis nerii*. **Brittnay Carlile*, Shawn Krosnick, and Cameron Sweisthal**, *Tennessee Technological University, Cookeville, Tennessee*. Two common insects that feed on the vascular tissues of plants are spittlebug nymphs (*Clastoptera spp*.) and aphids (*Aphis spp*.) (Hemiptera). Both genera have specialized feeding stylets that allow for tapping into the xylem, phloem, or both. They secrete saliva that hardens to form an impervious and air-tight sheath for feeding. If disturbed, these insects often remove their stylet immediately and relocate, making it difficult to study their feeding behavior. In fall 2020, collection methods were optimized using insects feeding in the native plant garden at Tennessee Tech University. *Clastoptera xanthocephala* and *Aphis nerii* were documented on *Helianthus tuberosus* and *Asclepias syriacus*, respectively. Liquid nitrogen was poured on the plant/insect to maintain the stylet/sheath connection. The sample was immediately placed into liquid nitrogen, gradually transitioned into fixative, paraffin embedded, and thin sectioned. This method provided good quality preservation of the sheath and insect/stylet connection for both spittlebug and aphid.

2-03 Anatomical diversity of evolutionarily convergent egg mimics in passion flowers (*Passiflora* L.). **Charis Littell* and Shawn Krosnick**, *Tennessee Technological University, Cookeville, Tennessee*. *Passiflora* (passion flowers) is a large genus well known for its morphological diversity and close associations with butterflies. Many *Passiflora* possess structures that mimic butterfly eggs, discouraging gravid butterflies from laying eggs, thus reducing the number of caterpillars that would feed on the plant. These structures are varied in form and position and have evolved independently many times. This study will document and compare the structural homology of egg mimic structures in the genus. Multiple examples of egg mimics were paraffin embedded and sectioned with a microtome and stained to differentiate among the types of egg mimics. Preliminary results suggest that at least four classes of egg mimics exist: those derived from aborted flower buds, the leaf apex, the stipule apex, and from abaxial nectaries. These structures are not homologous but instead represent convergence in creating a visual display that confers a significant advantage in decreasing herbivory.

2-04 Examination of Stylar Movement Among Floral Morphs in Passiflora incarnata L. **Kayla Sorensen* and Shawn Zeringue-Krosnick**. *Tennessee Tech University, Cookeville, Tennessee*. *Passiflora incarnata*, or purple passionflower, is a native vine found throughout the Southeast United States. *P. incarnata* typically exhibits movement of the style as soon as the flower opens, where styles are initially upright and gradually descend until they are level with the anthers. However, not all flowers exhibit this pattern: four morphs are recognized, each differing in stylar movement. Styles remain upright in morphs 1 and 2, bend slightly in morph 3, and descend fully in morph 4. To better understand the mechanisms behind stylar movement in *Passiflora*, this study compared the regions of movement across each morph. Larger cells were frequently observed on the abaxial side of the style near the apex of the ovary, while smaller cells were observed on the adaxial surface. Differences will be compared across the morphs at both the cellular and tissue level to better understand how stylar movement is regulated in *Passiflora*.

Cell & Molecular Biology Posters

3-01 Genetic analysis of a pantropical sea urchin at the southeastern edge of a Caribbean population. **Faith A. Sherrow* and Douglas R. Dorer**, *University of Tennessee Southern, Pulaski, Tennessee*. *Echinometra lucunter*, the rock boring urchin, lives in shallow waters in the Caribbean Sea and along the tropical Atlantic coasts of South America and Africa. DNA sequencing of the mitochondrial cytochrome oxidase subunit I (COI) gene has shown that gene flow between *E. lucunter* populations in the Caribbean and the Atlantic is limited. The species is common along the northeast coast of Trinidad at the southeasternmost edge of the Caribbean Sea, though very little published information on the occurrence of this species or on marine invertebrate diversity in Trinidad is available. As part of a larger research program documenting the distribution of marine organisms in Trinidad, we are studying the genetic diversity of *E. lucunter* from this region. Phylogenetic analysis of COI gene sequences reveals that all urchins collected from three sites belong to the Caribbean clade of this species.

3-02 Connecting genes to genetically modified organisms. **Kayden Fletcher*, Oumie Njie*, Laura Bechard, and Julie Baker Phillips**, *Cumberland University, Lebanon, Tennessee.* Genetically modified organisms are a very prominent and divisive topic in today's world. Many people are willing to comply with higher prices to avoid the presence of GMOs in their food products due to high public concern about the safety of foods containing GMOs. However, there is not a strong connection between genetically modified organisms in food and negative effects to human health. In this study, various corn and soy-containing foods marked as being GMO-free and unmarked control foods will be tested for the presence of genetically modified organisms using polymerase chain reaction and gel electrophoresis. Due to the fact that cross-contamination in crop production is common, and 93% of corn and soy crops are genetically modified, we expect that many of our tested food products will be incorrectly labeled. We will present these findings, and briefly discuss prevalence of gluten sensitivities across humans using the 1000 genomes project.

3-03 Molecular identification of zoantharians (Cnidaria: Hexacorallia: Zoantharia) from Trinidad, southern Caribbean. **Stanton G. Belford**, *University of Tennessee Southern, Pulaski, Tennessee*. Zoantharians are colonial cnidarians commonly found in the Caribbean Sea, and are biodiverse throughout its globally distribution. Although *Palythoa* and *Zoanthus* spp. occur at Toco, Trinidad, species identification have continually been challenging due to unclear and difficult morphological identification, such as: oral disc and tentacle color. Molecular techniques, such as DNA barcoding have standardize the use of molecular markers, where an applicable range of markers must be used to accurately identify species. This study compares results from COI and mitochondrial 16S ribosomal DNA for zoantharian identification located at Trinidad, southern Caribbean. Results for 20 zoantharian samples showed differentiation of species to be: *Palythoa caribaeorum*, *Palythoa grandiflora*, *Zoanthus pulchellus*, *Zoanthus sociatus*, and *Zoanthus sansibaricus*. This is the first molecular analyses of zoantharians in this region of the Caribbean Sea, and both markers are considered to be reliable for future zoantharian identification, which will assist in coral reef surveys on zoantharian distribution.

3-04 The antimalarial compound Amodiaquine induces an apoptotic program in HCT116 cells. **Francesca Dempsey* and Chris Barton**, *Belmont University, Nashville, Tennessee*. Amodiaquine is an antimalarial drug that has shown promise as an anticancer treatment. Previously, our laboratory identified that amodiaquine is highly effective at reducing the viability of a number of cancer cell types grown in culture. However, the mechanism behind this reduction in cell viability is currently unknown. In this project, we hypothesized that amodiaquine blocked cellular growth through the induction of a caspase-independent apoptotic signaling program. Our data suggest that exposure to amodiaquine is sufficient to activate caspase enzymes and induce apoptosis in HCT116 colorectal cancer cells. These data provide mechanistic insight to how amodiaquine is functioning as an anticancer therapeutic. Further experiments are underway to determine whether this drug functions similarly in other forms of cancer.

3-05 The effects of *twist1* and *twist2* on sclerotome differentiation into tendon progenitors in zebrafish. **Marinia Bishay* and Nikki Glenn**, *Belmont University, Nashville, Tennessee*. Somites are important mesoderm structures that form in regularly timed intervals from the anterior end of the paraxial mesoderm at the end of gastrulation during embryogenesis. Cells of the ventromedial portion of the somite, the sclerotome, undergo epithelial to mesenchymal transition, surround the notochord, and give rise to connective tissues of the axial skeleton including the vertebrae, tendons, and ligaments. We are interested in understanding how the sclerotome is compartmentalized into the region that makes tendons. Genes expressed in the sclerotome, *twist1b* and *twist2*, are likely involved in the downstream differentiation of sclerotome to become tendon progenitors. Previous studies have shown that Tgf-beta signaling is important for tendon formation. We are investigating how knockdown of twist1b and twist2 affects Tgf-beta expression in early tendon precursors derived from the sclerotome in zebrafish embryos. These studies will elucidate the role *twist1b* and *twist2* play during sclerotome differentiation to tendon cells during embryogenesis.

3-06 Exploring anandamide's role in embryonic zebrafish development. **Jack English*, Anna Wilkins* and Nikki Glenn.** *Belmont University, Nashville, Tennessee*. An explosion in research on the endocannabinoid system has revealed how the system acts on the central and peripheral nervous system, and other organs. The endocannabinoid system is composed of endogenous cannabinoids like anandamide, which bind to the CB1 and CB2 receptors. Anandamide is an endogenous fatty acid neurotransmitter known to affect various physiological processes, including appetite regulation, reproduction, and lipid metabolism. The presence of Cnr1 and Cnr2 (zebrafish receptors homologous to CB1 and CB2) receptors eleven hours post-fertilization suggests anandamide's involvement with embryonic development. Zebrafish embryos received anandamide drug treatments for three days after birth and were observed for developmental defects. We observed cardiac defects and smaller eye size after exposure to exogenous anandamide. This research can help us better understand the importance of the endocannabinoid system on embryological development as many states begin to legalize marijuana.

Chemistry Posters

4-01 Computational design and verification of novel inhibitors of dihydrofolate reductase in three bacterial species. **Allison Adams* and Derek J. Cashman**, *Tennessee Technological University, Cookeville, Tennessee*. Small molecule inhibitors of bacterial Dihydrofolate Reductase (DHFR) were computationally designed with the goal of obtaining broad-spectrum antibiotics against three bacterial diseases, *Bacillus anthracis* (anthrax), *Staphylococcus aureus*, and *Mycobacterium tuberculosis*. Inhibitors were designed using the MOE 2020 computational modeling suite targeting the DHFR active site based on analysis of energetic frustration and evolutionary importance of amino acids. This analysis provided a guide for docking studies of 189 small molecules that were designed to interact with specific functional groups based on complementary, non-covalent interactions. Compounds were further screened for ADME properties in humans using Lipinski's Rules of Five. The three most favorable potential antibiotics were identified and simulated using 100 ns molecular dynamics simulations to verify and refine the docking results. The simulations were conducted using NAMD v.2.9. on TTU's HPC cluster. VMD was used for analysis of simulations, which indicate stable trajectories for each drug complex and suggest the compounds are good candidates for inhibition.

4-02 Synthesis of iridescent colorants via silane functionalization of pigments. **Andrew K. Nguyen* and William R. Carroll**, *Tennessee Technological University, Cookeville, Tennessee*. The formulation of new colorants that are both inherently colorfast and stable is an active area of research. By utilizing tetraethyl orthosilicate (TEOS) to form shells around colored substrates they may be enhanced with a greater reflective ability resulting in an iridescent effect. The size of this particle can contribute to the refraction of light of a similar wavelength to produce a structural coloration. The Stöber process was used to produce glass nanoparticles that refract blue light. When dried on top of black carbon media, the nanoparticles aggregate in layers and are visibly bluer than when dried on clear media. With the manipulation of the size of the particles and substrate the nanoparticles are deposited on, a range of semi- to truly iridescent colors can be created. By modifying the Stöber process to incorporate different functionalized silanes and pigments, this work explores the creation of more stable and vibrant colorants.

4-03 Understanding the chemistry behind fabric dyeing process. **Avery Moser*, Emelia Beck*, and Anuradha Liyana Pathiranage**, *Austin Peay State University, Clarksville, Tennessee*. The purpose of this experiment is to find the best method of dyeing fabric samples by using synthetic dye solutions to determine which conditions best suit the fabric and the dye. The experiment will be testing how different dye bath solutions, fabrics, mordants, pH conditions, and temperatures work together to create the best environment for a long-lasting dye bond. This experiment will be used to determine how the functional groups of the dye interact with fabrics to create chemical bonds, and which method of dyeing does not damage the fabric. The experiment will be evaluating which pH will create a better dye bond and, by keeping in mind that temperatures have the ability to alter pH, how temperatures affect the integrity of the acid dye and the pH of the solution and finally establish a prime environment for fabric-dye bonding in acidic condition.

4-04 Enhancing the analytical confidence of dye identification using Raman spectroscopy, surface-enhanced Raman scattering (SERS), and mass spectrometry (MS) with microwave-assisted analyte extraction.. **Biliquis Y. Bintinlaiye*, Beng G. Ooi, and Ngee S. Chong**, *Middle Tennessee State University, Murfreesboro, Tennessee*. The identification of dyes is commonly carried out for products including foods, beverages, textiles, cosmetics, color powders, and polymeric products. Due to the use of thousands of dyes for various applications and the availability of structurally similar dyes, analytical identification of dyes based on a single technique is challenging. Using examples from color powders and textile fibers, it was demonstrated that Raman, SERS, and MS techniques are complementary in their ability to identify dyes without the spectral interferences from the confounding sample matrices. Microextraction techniques based on microwave-assisted extraction of sub-milligram samples are found to be suitable for dye identification.

4-05 Spectroscopic characterization of liquid state hydantoin drugs. **Brayden Copeland* and O. Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. The hydantoin scaffold is present in many antiseizure, antiviral, anticonvulsant, or antiulcer medication. The topical application of various hydantoin drugs has also shown effectiveness in treating chronic wounds. As most pharmaceuticals, hydantoin drugs exist in solid state and exhibit polymorphism (the existence of multiple crystal structures) which can decrease their pharmaceutical efficacy. Converting the solid-state hydantoin drugs into a liquid-state (or ionic liquids) can prevent their polymorphism and opens up new delivery methods. The hydantoin drugs either are administered as sodium salts or exist as neutral compounds which can be easily deprotonated making these compounds ideal anion precursors. The focus of this study is to investigate if the ionic liquid strategy can be applied to hydantoin drugs. Hydantoin and 5,5-dimethylhydantoin were reacted with three cation sources (tetrabutylammonium hydroxide, tetrabutylphosphonium hydroxide, and choline hydroxide) and the identity of the resulting liquid state compounds was investigated using nuclear magnetic resonance spectroscopy.

4-06 Incorporating fluoro-tryptophan into JNK3 in chemically defined media. **Brian Chong*, James Dethero-London*, William Carroll, Jeffrey Boles, and Xuanzhi Zhan**, *Tennessee Technological University, Cookeville, Tennessee*. c-Jun N-terminal Kinase 3 (JNK3), a member of Mitogen-Activated Protein kinases (MAPK), regulates signal transduction events related to essential cellular processes including differentiation, apoptosis, and proliferation. JNK3 has been recognized as a therapeutic target for neurodegenerative diseases, such as Parkinson's and Alzheimer's. This project seeks to elucidate the potential binding induced conformational changes of JNK3 protein by using 19F Nuclear Magnetic Resonance (NMR) spectroscopy. This study uses site specific incorporation of fluorine tags onto proteins using chemically defined media, which seeks to deprive cells of tryptophan. Through the addition of 5-fluoro-indole to the media, a fluorinated precursor to tryptophan, 5-fluoro-tryptophan can be synthesized in cell by tryptophan synthase. For expression of JNK3 in this media, we will optimize the conditions by adding several nutrient additives (serine, and PLP) to increase the number of fluorinated proteins. Preliminary results demonstrate that addition of serine and PLP can increase production of functional JNK3.

4-07 Investigating the transdermal delivery potential of thioridazine liquid state compounds. **Claire E. Rust and Oana Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. Thioridazine hydrochloride is a solid-state drug effective in treatment of mental illnesses such as schizophrenia; as a drawback, thioridazine causes cardiac arrythmias. Along with this issue, its existence as a solid-state compound is known to lead to polymorphism, meaning that thioridazine exhibits multiple crystalline structures (or polymorphs) that can change its pharmaceutical activity. Converting thioridazine into a liquid state would eliminate the existence of various polymorphs, while providing a higher bioavailability and additional delivery methods. To address these issues, thioridazine cation was combined with lidocaine cation (a drug used in the treatment of cardiac arrythmias) and docusate anion (an anionic surfactant known as a penetration enhancer) in three different molar ratios to form three new liquid state dual functional drugs. The transdermal delivery potential of the new compounds was also investigated by using a Franz cell apparatus, the setup commonly used in formulation development for the in vitro skin permeation studies.

4-08 Delivery of liquid state asthma drugs from silica solid supports. **Devon Cotter* and O. Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. Ionic liquids have a wide array of tunable attributes and chemically synergistic effects that can allow for enhanced pharmaceutical performance. However, their handling presents a potential drawback specifically due to their increased viscosity, often higher than 100 cP. Adsorption of viscous ionic liquids onto a solid drug carrier via the supported ionic liquid phase strategy affords an enhanced ease of handling while leveraging targeted drug release. Per previous research, successful pairing of protonated albuterol asthma drug with salicylate anion was observed, leading to the formation of albuterol salicylate, [Alb][Sal], as a highly viscous liquid. The focus of this research was on the addition of solid handling to the synthesized [Alb][Sal] ionic liquid via its adsorption onto mesoporous silica of two distinct mesh sizes, followed by a fully informed investigation of the delivery of [Alb][Sal] into an aqueous, biologically simulated environment – namely, simulated gastric fluid (SGF) of pH = 1.2.

4-09 Development of a Field Test for Identification of Cocaine and Heroin Utilizing Thin Layer Chromatography. **Emma Schrider*, Claudia McDavid*, and Jeffrey O. Boles**, *Tennessee Technological University, Cookeville, Tennessee*. Usage of heroin and cocaine is increasing as a surrogate to opioids. This increase has resulted in the use of presumptive drug test kits in the field by law enforcement; tests that simply rely on color change. This has led to an increase in the number of false positives, which has a negative effect to the public. Examples include the Scott's test for cocaine and the Marquis color test for heroin. Diluents, cutting-agents and over the counter medications have shown to also give positive results for cocaine and heroin. This project's approach looks at stain reagents for cocaine and heroin as a presumptive use but with a technique more common to definitive analysis, thin layer chromatography (TLC). A TLC kit would be run by law enforcement in the field. Preliminary studies have focused on silica TLC plates with cobalt (II) thiocyanate (cocaine and heroin) and KMnO4 (heroin) utilization for staining.

4-10 Demethylation of amphetamine-type stimulants by ultraviolet light during tertiary treatment at the Cookeville Wastewater Treatment Plant. **Haley M. Mayse* and Tammy H. Boles**, *Tennessee Technological University, Cookeville, Tennessee*. Amphetamine, methamphetamine, 3,4-methylenedioxymethamphetamine (MDMA), and 3,4-methylenedioxyamphetamine are Amphetamine-Type Stimulants (ATS) that are prescribed for attention-deficit hyperactivity disorder and obesity but are also often illegally manufactured and used. After ingestion, 34 – 76% of ATSs are excreted unchanged ingestion, depending on the pH of urine and on the ATS. During wastewater treatment and exposure to UV light, methamphetamine and MDMA will likely undergo indirect photolysis. This project will study indirect photolysis to determine whether methamphetamine and MDMA will decompose into amphetamine and MDA respectively, with formaldehyde as a byproduct. Liquid chromatography-tandem mass spectrometry will be used to analyze the compounds of interest. The mechanism of degradation will also be proposed and determined.

4-11 Synthesis and analysis of curcumin. **Hannah Motes* and Anuradha Liyana Pathiranage**, *Austin Peay State University, Clarksville, Tennessee*. Curcumin, a compound found in Curcuma longa, is an antiinflammatory and antioxidant agent that is of interest to the medical field for its anticancer activity. It is difficult to isolate curcumin from other curcuminoids during extraction from Curcuma longa. Synthesis of curcumin allows for analysis of the individual compound. In this project, curcumin was synthesized through an aldol reaction with acetylacetone and vanillin-ethyl acetate, using BF3 as a catalyst. The reaction progression was assessed via thin-layer chromatography. The reaction occurs slowly and is being assessed to determine how long the reaction takes to produce curcumin. The goal of this research is to further modify the synthesis procedure to synthesize curcumin that can be structurally analyzed through gas chromatography−mass spectrometry (GC−MS) and nuclear magnetic resonance (NMR) spectroscopic methods.

4-12 Towards dual functional liquid state asthma drugs. **Jacob Thorn* and Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. Albuterol and montelukast are two common active pharmaceutical ingredients (APIs) use in the management of asthma. Albuterol can be critical in managing bronchoconstriction and is listed on the World Health Organization's Essential Medicines List. Montelukast is an immunomodulant leukotriene inhibitor, which decreases the inflammatory response in the patient's airways. Albuterol is an ideal cationic constituent of an ionic liquid due to its ionizable secondary amine group, while montelukast possesses a carboxylic acid group that can be used as a proton donor to form an anionic constituent. A sufficient difference in pka between albuterol and montelukast suggests the potential for successful ionic liquid (IL) synthesis incorporating both APIs. Here, both albuterol and montelukast were combined in situ with choline cation and docusate anion to form dual functional ILs and double salt ionic liquids (DSILs). ATR-FTIR as well as NMR Spectroscopy were used to confirm identity and successful synthesis.

4-13 Characterization of binding-induced conformational changes of arrestin-3 using 19F-NMR. **James Dethero-London*, Brian Chong*, William R. Carroll, and Xuanzhi Zhan**, *Tennessee Technological University, Cookeville, Tennessee*. Arrestins, a small family of multi-functional scaffold proteins, play essential roles in G-protein coupled receptor (GPCR) signaling. Due to the many signaling pathways they are involved in, understanding arrestin structure and dynamics could be important for developing therapeutics for a variety of diseases such as Alzheimer's and Parkinson's. This project seeks to better elucidate the mechanisms through which arrestin-3 mediates these signaling pathways with the use of 19F Nuclear Magnetic Resonance (NMR) spectroscopy analysis of interactions and conformational changes associated with binding known partners such as IP6 and kinases from JNK cascades, including ASK1, MKK4 & 7 and JNK3. We employ two different methods for 19F incorporation into arrestin-3: (1) unnatural amino acid (F-Trp) incorporation and (2) specific labeling on cysteine residues. Initial results show successful purification and 19F signal acquisition of arrestin-3 variant K400W, suggesting the tryptophan synthase-mediated Trp fluorination method works.

4-14 Determination of concentrations of food dyes in powdered drink mixes. **Madeline S. Herndon* and Sarah S. Pierce**, *Cumberland University, Lebanon, Tennessee*. In order to examine the amount of food dyes in various powdered drink mixes, solutions of different concentrations of FD&C food dyes were prepared. The food dyes used were Red 40, Blue 1,Yellow 5, and Yellow 6. The solutions' absorbances were measured using a spectrophotometer, and calibration curves were produced. To assess the amount of food dye in the powdered drink mixes, solutions of the powders were diluted with distilled water. Then, depending on the transparency of the solutions, the solutions were centrifuged to provide clarity for the absorbance readings. Using the calibration curves for the individual food dyes, the quantities of food dyes contained in various powdered drink mixes were then determined.

4-15 Computational design and docking of *Hamigeromycin* B natural product derivatives in 26 human kinases. **Meagan Edmonds*, Derek J. Cashman, and Jesse D. Carrick**, *Tennessee Technological University, Cookeville, Tennessee*. *Hamigeromycin* B analogs are synthetic natural product derivatives with potential for mediating signal transduction in human kinases. To study potential activity, 11 Hamigeromycin analogs were constructed using MOE 2020 and optimized using AMBER14:EHT. The analogs were docked into 26 human kinase structures obtained from the Protein Data Bank using the Docking module of MOE 2020. The docking sites in each kinase were targeted using the Protein Frustratometer and Evolutionary Trace to characterize the energetics and evolutionary importance of amino acids for contributions to binding. The lowest binding free energy scores were used to determine the best binding and orientation of each analog to each protein. The data suggests that five of the 26 kinases are potential targets for further study. New compounds for study were computationally designed by systematic modification of functional groups in the original analogs. All compounds were then subjected to conformational search and further refinement using AM1 semiempirical quantum mechanics in Gaussian '09. All compounds were docked again to each kinase with additional pharmacophore modeling.

4-16 The development of an isoform-specific JNK3 inhibitor. **Megan E. Wharton*, Sekyere Boateng, and Xuanzhi Zhan**, *Tennessee Technological University, Cookeville, Tennessee*. Mitogen-activated protein kinases (MAPK) are involved in a variety of signal transduction mechanisms as a response to a wide range of cellular stress stimuli. The ASK1/MKK/JNK protein kinase cascade is involved in such signal transduction. The dysfunction of these cascades has been identified to impact downstream signaling effectors linked with the onset of neurodegenerative diseases. c-Jun N-terminal kinases (JNK) are attractive therapeutic targets due to the rising interest in developing treatment therapies for neurodegeneration. Among the ten JNK isoforms (JNK1α/β-1/2; JNK2α/β-1,2; JNK3α-1/2), the two JNK3 isoforms are found almost exclusively within the Central Nervous System (CNS). The objective of this work is to develop an isoform specific JNK3 inhibitor based on the structural interactions of JNK3 with its upstream kinases. Based on preliminary kinase assays comparing JNK3α2 and JNK2α2, it was supported that the Maltose Binding Protein (MBP)-fusion peptide inhibitor MJ40 was successful in isoform specificity in favor of JNK3α2.

4-17 Comparison of size and polydispersity of pigment nanoparticles synthesized in batch, flow, and plug flow conditions. **Nathan Colwell* and William Carroll**, *Tennessee Technological University, Cookeville, Tennessee*. Pigment nanoparticles with well-defined size and structure are promising materials for the production of structural colorants. The size and polydispersity of nanoparticle scale pigments has been shown to effect their optical properties in numerous ways. Flow chemistry has exhibited precise control over reaction conditions and has yielded nanoparticles of well-defined size. The use of plug flow reactors has incorporated a means of limiting reagent availability and has been used to control the size of polymers produced in flow. Here, three methods of producing nanoparticle scale pigments were compared. These methods are batch, flow, and plug flow. The polydispersity of the particles produced was measured by SEM and reported here.

4-18 Synthesis and analysis of bisphenol A epoxy resin. **Nicholas Desing * and Anuradha Liyana Pathiranage**, *Austin Peay State University, Clarksville, Tennessee*. Epoxy resins are low molecular weight organic compounds used in the manufacturing of adhesives and plastics. They contain multiple epoxide groups and are prepolymer thermosetting compounds capable of forming hardener products with a variety of organic compounds. The formation of this hardener involves what is known as a curing agent, which is a compound that introduces very tight crosslinking and possible irreversible changes to the epoxy resin to form a solid with high mechanical and chemical resistive properties. There are many classes of curing agents, each capable of producing different levels of crosslinking under different reaction conditions. During the curing process, reaction conditions can be manipulated to change the appearance of the epoxy and provide a more efficient curing rate. A common bisphenol A epoxy resin was reacted with a polyamide curing agent in a variety of reaction conditions to determine which provides the most desirable crosslinking and cure rate.

4-19 Quaternary ammonium and phosphonium cations for the synthesis of juglone ionic compounds. **Rachel Paris*, Twanelle Majors, and O. Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. 5 hydroxy-1,4-napthoquinone, juglone, is a naturally occurring quinone type organic compound with numerous biological properties; this compound is a well-known antifungal agent, has cosmetic significance as a colorant, and has the potential to be used as an herbicide. Use of juglone as an herbicide is limited by several drawbacks, particularly with its drift to non-target species. To be used as an effective herbicide, juglone's mobility needs to be controlled by altering its aqueous solubility and volatility. This can be achieved through using the ionic liquid strategy to form new juglone ionic derivatives. The work presented here focused on combining the juglone anion with four quaternary ammonium cations and one phosphonium cation to synthesize five new juglone ionic derivatives that were further characterized using NMR Spectroscopy.

4-20 Synthesis of a novel Terpenoid and optimization of its preparation for yield and environmental impact using Design of Experiment (DOE). **Sydney Asmus*, Taylor Fletcher*, and William Carroll**, *Tennessee Technological University, Cookeville, Tennessee*. The use of certain solvents in chemical reactions can cause negative environmental impacts. The goal of this work is to synthesize a novel terpenoid for use as topoisomerase inhibitors and optimize this synthesis for both yield and environmental impacts. The reactions are analyzed by a green scoring software, DOZN, that provides a quantitative scoring of its environmental impact. This research optimized a green reaction on the microliter scale using design of experiment (DOE) procedures with nuclear magnetic resonance (NMR). The reporting of synthesis of a terpene derivative including an F19 label and the optimization of its synthesis using DOE for its ideal DOZN score. A standard procedure that optimizes multiple reactions while also remaining fiscally competitive with non-green alternatives was developed.

4-21 Synthesis of pharmaceutically relevant terpene derivatives for use as topoisomerase inhibitors. **Taylor Fletcher*, Sydney Asmus*, and William Carroll**, *Tennessee Technological University, Cookeville, Tennessee*. Topoisomerase inhibitors play an important role in the fight against cancer. The focus of this research is to create a suite of pharmaceutically relevant terpene derivatives that can then be evaluated for usefulness in inhibiting topoisomerase. Multiple aldehydes have been chosen to be evaluated, all containing 19F. The targets of this work are terpenoids based on the diterpene carvone. The target molecules have synthetic handles that allow expansion to a known family of topoisomerase inhibiting diterpenes, the trachylobane family. While the inclusion of the 19F label here allows for the analysis of the protein interactions that these terpenoids participate in. The scope of this synthesis and the novel molecules produced were evaluated for reproducibility and usefulness in the inhibition of topoisomerase.

4-22 Electrochemical investigation of 10-[5'-(N-Diethylamino) pentyl]-2-chlorophenoxazine (DPCP) and its applications in redox titrations involving chloramine-T. **Kuntebommanahalli N. Thimmaiah, Mark Montgomery, Padma Thimmaiah, Darrell Barnes, Piyatilake Adris, Paul Grisham, Sarah Holt, and Lindsay Massie**, *Northwest MS Community College, Senatobia, Mississippi.* DPCP undergoes a reversible one-electron oxidation with cerium (IV) to form [DPCP+•], which further undergoes a second one-electron oxidation to form di-cation [$DPCP^{2+}$]. The cyclic voltammogram of DPCP exhibited two anodic waves at 760 mV and 1170 mV and two cathodic peaks at 688 mV and 1020 mV at a scan rate of 50 mV/sec. The peak at 760 mV corresponds to [DPCP+•] and the second anodic peak at 1170mV corresponds to [$DPCP^{2+}$]. Oxidation of DPCP by bromine in acid medium resulted in three products as evidenced by HPLC. In order to explore the analytical applications, conditions for the successful use of DPCP as a redox indicator in the macro and micro estimation of biologically important compounds using chloramine-T have been optimized.

4-23 Synthesis of 2-(6-(5,6-(diphenyl)-1,2,4-triazin-3-yl) pyridin-2-yl)-5-(diversified benzo)-1,3,4-oxadiazole via iodide-mediated reaction. **Fortune O. Dzeagu* and Jesse D. Carrick,** *Tennessee Technological University, Cookeville, Tennessee.* Emission-free energy demand keeps rising as the impacts of global warming increase. Nuclear energy is one of the CO_2-emission-free energies. However, nuclear waste management is the major challenge of nuclear energy production. In Selective Actinide Extraction (SANEX), bis-1,2,4-triazinyl pyridine (BTP) ligands have been found to chemo-selectively separate minor actinides (An) from lanthanides (Ln). Current efforts in this lab involve synthesis of novel 2-(6-(5,6-(diphenyl)-1,2,4-triazin-3-yl) pyridin-2-yl)-5-(diversified) benzo-1,3,4-oxadiazole (MTP-1,3,4-oxadiazole) scaffolds as part of developing soft Lewis-basic tridentate ligands for minor An separation. This experimental effort focuses on condensation of mono-1,2,4-triazinyl pyridine (MTP) aldehydes with various benzo-hydrazides. The resulting hydrazones were thermally cyclized to afford the desired 1,3,4-oxadiazole MTPs with 80-90% yields. The 1,3,4-oxadiazole scaffolds synthesized show intramolecular C-O cyclization via transition-metal-free iodide-mediated oxidation. Collaborators will examine the solubility and efficacy of these scaffolds with respect to their effectiveness in An and Ln separation. Method optimization and preliminary synthesized scaffolds will be reported.

4-24 Chemoselective green oxidation of heteroaryl isoprenes toward functionalized methyl ketones. **Connor C. Pinson*, Alex M. Stovall*, Zachary Z. Gulledge*, and Jesse D. Carrick,** *Tennessee Technological University, Cookeville, Tennessee*. With increased discussions involving energy and climate issues, nuclear energy has become a topic in modern research. Although nuclear energy has a small carbon footprint, it produces spent nuclear fuel (SNF). With the goal of selective separation of specific daughter nuclides from SNF, prior work focused on symmetrical examples, bis-[1,2,4]-triazinylpyridines, which showed chemoselectivity for actinides over lanthanides. Currently, the project's goal is to synthesize and purify functionalized methyl ketones for downstream cyclizations. Common acylation methods do not give the desired product when pyridines were present. The group utilized a Suzuki-Miyaura cross-coupling reaction for the addition of the isopropenyl group which undergoes a green oxidation to afford the methyl ketone. This method leverages potassium permanganate as the oxidant along with sodium paraperiodate resulting in the desired products. These ketones will be used for downstream cyclization toward 1,2,3-triazolyl pyridines. The reaction conditions and substrate scope will be disclosed at a later time. Synthesis of 2-(6-(5,6-(diphenyl)-1,2,4-triazin-3-yl) pyridin-2-yl)-5-(diversified benzo)-1,3,4-oxadiazole via iodide-mediated reaction.

4-25 Aliphatic dicarboxylic acids as anion precursors for liquid state aliphatic phenothiazine drugs. **Ross Kinnaird*, Caroline Hunter, and O. Andreea Cojocaru**, *Tennessee Technological University, Cookeville, Tennessee*. Dicarboxylic acids are organic compounds that have the potential to be used as anion precursors in the formation of ionic compounds. Liquid-state ionic pharmaceuticals are compounds with melting points less than normal body temperature and with less side effects and improved properties when compared to their solid-state counterparts. This research focuses on the liquid forming potential of several aliphatic dicarboxylic acids (adipic, azelaic, glutaric, pimelic, suberic, and succinic acid) when they are reacted in stoichiometric molar ratios with four different aliphatic phenothiazine drugs (chlorpromazine, promazine, promethazine, and triflupromazine) as cation precursors. Twenty-four new phenothiazine dicarboxylates were synthesized using known synthetic procedures and the identity and purity of the synthesized compounds was investigated using spectroscopic techniques.

Ecology & Environmental Science Posters

5-01 Effects of Aquatic Insect Abundance and Biomass on Bat Species Diversity. **Trevor G. Walker, Sarah C. Zirkle, Sarah K. Krueger, Gene Zirkle, and Catherine G. Haase**, *Austin Peay State University, Clarksville, Tennessee (TW, SZ, SK, CH), and U.S. Army Fort Campbell, Fort Campbell Fish and Wildlife, Kentucky (GZ).* Due to the reliance of North American bat species on aquatic insects for forage, we suspect there should be a link between stream health and metrics of bat diversity. We assessed this hypothesis using metrics of bat diversity and aquatic insects. We captured bats via mist nets on Fort Campbell Army Base, KY and calculated species richness and Simpson's Diversity Index. Insects were collected, identified down to family, dried, and weighed. We assigned family averages of tolerance values and calculated the Family Biotic Index for each location. We calculated percent abundance and percent biomass comprised of Ephemeroptera, Plecoptera, and Trichoptera at each location. We used a generalized linear model to relate bat diversity indices to aquatic insect metrics and included weather variables and Julian date as covariates. Preliminary results show that percent Ephemeroptera, Plecoptera, and Trichoptera abundance is the only significant variable explaining bat species evenness.

5-02 Evaluation of physical and biological characteristics of an un-altered section of stream within an otherwise straightened channel in northwest Tennessee. **Chloe Smotherman* and Tom Blanchard**, *University of Tennessee at Martin, Martin, Tennessee*. Channelization is known to cause degradation of biotic communities in aquatic systems. Nearly all streams in West Tennessee have been straightened to improve navigation and drainage. The West Tennessee River Basin Authority (WTRBA) has undertaken several stream re-structuring projects to improve physical and biological functioning. These projects include relatively short reaches of stream within straightened channels. We identified a section of Mud Creek in Obion Co., TN that appears un-altered from its original meandering form. We compared physical features and assemblage characteristics of fish and aquatic macroinvertebrates of the un-altered section to those of channelized reaches. Invertebrate sample size was too low for statistical comparison. We found significant differences between the two treatments in habitat quality scores, fish species diversity, and fish assemblage structure. An understanding of the biological and physical functioning of sections of un-altered streams within modified systems, could provide important information for future restoration projects.

5-03 Using community science data to assess the impact of urbanization and predation on Tennessee lizard species. **Eliana L. Blash, Isabel A. Hartwig, Haleema A. Shamsuddi, Emma C. Van Why, and Matthew J. Heard**, *Belmont University, Nashville, Tennessee*. Urbanization poses a significant threat to animals and can drive habitat loss and changes in species interactions. In this study we evaluated whether we could use citizen science data to analyze the impact of urbanization on seven lizard species and their exposure to predation in Tennessee. Using this approach, we downloaded occurrence data and photos for our seven species from 2016-2020. For individual photos we quantified predation risk by looking at injuries. To assess the impacts of urbanization on lizard species, we also looked to see if there were correlations between occurrence records and impervious surface cover. We found that different species are affected in different ways by predation risk and urbanization. Our results show that citizen science data is a valid approach to assess interspecific interactions and the impacts of urbanization.

5-04 Comparison of bat species diversity in an urban and a semi-rural location in Davidson County, Tennessee. **Jocelyne Lara*, Maria Aguirre*, Harrison Williams*, and Darlene Panvini**, *Belmont University, Nashville, Tennessee*. The occurrence of bats depends on the availability of suitable habitat and food resources, which can vary across the landscape in the transition from urban to rural locations. Each species of bat uses unique high-frequency calls to echolocate across the landscape. This study recorded bat echolocation calls and identified species to determine if bat species diversity differs between an urban and semi-rural setting. Bat calls were surveyed in one urban park and a semi-rural area of Davidson County, Tennessee using an Echo Meter Touch 2 at dusk, twice per week, during September and October 2021. Kaleidoscope Pro Analysis Software was used to confirm bat species identities. The data suggest slight differences in the occurrence of bat species between the two locations. Knowing which bat species occur in these settings provides insight into the habitats that bats rely on and what measures should be taken to preserve their niches.

5-05 Developing a method for mapping environmental justice factors by watershed. **Madison K. Moffitt* and Peter Li**, *Tennessee Technological University, Cookeville, Tennessee.* With increasing widespread awareness of Environmental justice (EJ) issues in recent years, our government has declared it essential to identify and address issues of communities with EJ concerns. While the Environmental Protection Agency (EPA) has developed the EJSCREEN GIS tool to aid in identifying those communities, it does not provide adequate information on how watersheds influence EJ factors. It is important for both state and federal governments to understand how EJ and environmental factors affect these communities within a watershed. With the effects of climate change becoming more pronounced, communities with EJ concerns will face the most impact. The purpose of this project is to develop a method for mapping watersheds (HOC10) with EJ factors, such as people of color, low-income, and indigenous communities alongside environmental factors such as flood zones, agricultural runoff, and superfund site proximity to further understand how these factors affect at-risk communities.

5-06 Summer habitat use and roost-site selection of a recently petitioned bat species. **Sarah C. Zirkle*, Sarah K. Krueger, Trevor G. Walker, Gene A. Zirkle, and Catherine G. Haase**, *Austin Peay State University, Clarksville, Tennessee, and Fort Campbell Fish and Wildlife, Fort Campbell, Kentucky.* Information on the spatial ecology and summer habitat requirements of the tri-colored bat (*Perimyotis subflavus*) is limited. As tri-colored bats are susceptible to white-nose syndrome, determining resources that are important for pre-hibernation fat stores is crucial. Our objective is to quantify summer roost site selection of tri-colored bats. We will capture, tag, and track bats using radio-telemetry to roost locations and record habitat characteristics. We will repeat these measurements for random trees to serve as available habitat. We will use a suite of mixed conditional logistic regression models with individual as a random effect to evaluate the relationships between covariates and habitat selection at the roost tree and individual level. Preliminary results from five bats demonstrate roost tree selection was influenced by roost tree height, which may be linked to microclimatic factors. Better understanding of summer habitat and proper forest management implications is needed for tri-colored bat management needs.

5-07 Impact of white-nose syndrome and local climate on reproduction of southeastern bats. **Sarah K. Krueger*, Trevor G. Walker, Sarah C. Zirkle, Joy M. O'Keefe, Gene Zirkle, and Catherine G. Haase**, *Austin Peay State University, Clarksville, TN (SK, TW, SZ, CH); University of Illinois, Urbana, Illinois (JO); and Environmental Division, US Army Fort Campbell, Fort Campbell, Kentucky*. Energetic trade-offs between hibernation and reproduction occur in bats to ensure pups are born with optimal forage availability, yet little is known about whether bats delay their reproduction as a response to disease, winter duration, and local climate. There is evidence of reproductive shifts in areas where white-nose syndrome (WNS) has devastated populations, which can be problematic if juveniles lack adequate time to gain fat before hibernation. However, research has not assessed these changes in response to climate. We compiled data from 1988-2020 and used linear mixed effects models to compare effects of WNS (presence and absence, years since WNS), winter duration, and local climate variables on the number of reproductive females for WNS-susceptible species and species not affected by WNS. We suspect that WNS susceptible species would see a decline in the number of reproductive females, with the effect exaggerated by longer winter durations and harsher climate variables.

Engineering & Engineering Technology Posters

6-01 The Maze: Scarecrow's revenge - developing an educational 3-dimensional game. **Cathryn Hunt*, and Saman Sargolzaei**, *University of Tennessee at Martin, Martin, Tennessee*. Interactive 3-Dimensional games can be classified as an active learning methodology to affect educational goals positively. Our work presents the development of a 3-Dimensional interactive game to promote the Tennessee corn. The game is developed in Unity engine (version 2020.3.12). It is a single-player, first-person perspective game, where the arrow keys make a farmer character navigate turns and obstacles within a corn maze. Scarecrows will appear over the game course and force the player to answer a trivia question about corn production and usage. The player moves forward unchanged with correct answers to the trivia questions; however, the player will lose a life from their five-life total with an incorrect answer. The goal is to escape the maze by correctly answering trivia questions, navigating the maze, and finding bonus lives scattered throughout. The presentation discusses the design process of player movements, camera movements, objects interactions, and other gameplay mechanics.

6-02 Dynamic patterns of particle size distribution of nonliving natural organic matter. **Katherine E. Slamen*, Kathlyn N. Mealio*, Holly A. Stretz, and Martha J.M. Wells**, *Tennessee Technological University, Cookeville, Tennessee (KS, KM, HS) and EnviroChem Services, Cookeville, Tennessee (MW)*. Humic acid (HA) falls under the category of nonliving natural organic matter (NNOM) and displays dynamic behavior under various conditions. This dynamic behavior presents a problem in water treatment as HA is a foulant and tends to aggregate and disaggregate. The relationship between the aggregation time of NNOM found in pond water as a function of shear rate was investigated under constant 0.4 M CaCl2 concentrations. A rheometer with a cup and bob attachment was used to induce shearing of the NNOM in the range of 10 to 400 sec-1. Dynamic light scattering (DLS) was then utilized to determine particle size distribution (PSD) patterns as the mixture was allowed to relax over 120 minutes. The dynamic behavior of particle sizes 73nm, 430nm, and 5μm were explored. Further analysis also suggests that there may be relationships between the growth or decay of specific particle sizes when exposed to specific shear rates.

Geology & Geography Posters

7-01 To reuse or not to reuse: A comparison of wastewater systems. **Aria McElroy*, Anish Jantrania, Terry Gentry, Janie Moore, Anna Hillburgh, Timothy Guevara, and Paul Fields**, *Tennessee State University, Nashville, Tennessee (AM), Texas A & M, College Station, Texas (AJ, TG, JM, AH, TG), Prairie View University, Prairie View, Texas (PF)*. Wastewater treatment in Texas is a very important issue that many counties have struggled with in recent years. The objective of this project was to analyze multiple onsite wastewater treatments methods to decide which method is best for treating reclaimed water at the RELLIS Campus at Texas A&M University. Each method used to treat wastewater had samples analyzed to detect fecal bacteria, total nitrogen, ammonia, heavy metals, and various other contaminants in the water. There were four treatment options to treat the wastewater from the RELLIS Campus. The conventional septic system, aerobic treatment system, the ozonation method combined with distillation, and the membrane bioreactor. It was concluded that the ozonation method provided the best results for disinfecting wastewater.

7-02 Discovery, excavation, and taphonomy of Coon Creek mosasaurs. **James G. Evans* and Michael A. Gibson**, *East Tennessee State University, Johnson City, Tennessee, and University of Tennessee at Martin Coon Creek Science Center, Enville, Tennessee*. In 1915, Bruce Wade discovered Coon Creek Fossil Site in McNairy County, Tennessee. This Late Cretaceous shallow marine deposit was found to be a *lagerstätte* with a diverse fauna of mosasaur specimens: *Plioplatecarpus depressus*, *Halisarusus platyspondylus*, *Globidens dakotensis*, and *Mosasaurus hoffmanii*. The discovery of *Prognathodon overtoni* in 1989 added to the faunal list. This specimen included well-preserved cranial and some post-cranial material. The presence of this diverse mosasaur assemblage raises questions about the specific ecological niches they occupied and interactions with the rest of the Coon Creek fauna and between the various mosasaur taxa. The goal of this study is to help stimulate interest in Coon Creek by understanding how the mosasaur species lived, and how the Coon Creek specimens perished.

7-03 Strike-slip faulting near Spencer, Tennessee. **Laura Navarro Moreno*, Lexi Bowen*, and Michael Harrison**, *Tennessee Technological University, Cookeville, Tennessee*. Recent road construction along State Route 111 north of Spencer, Tennessee exposed 150 meters of fresh outcrop of Pennsylvanian Sewanee Conglomerate. Here, the Sewanee is a 40-meter thick cross-bedded conglomeratic quartz arenite that is yellowish-gray to yellowish-brown in color. The outcrops on the east and west side of the road contain numerous strike-slip and thrust faults associated with Alleghenian deformation and the formation of the Appalachian Mountains. This study aims to understand how these structures relate to the regional tectonics of the Cumberland Plateau. The orientation of faults in the outcrop were measured with a Brunton compass. Stereoplots show a northeast-southwest trend for the strike-slip faults; however, the thrust faults show varying orientations, perhaps due to reorientation by strike-slip fault zones. Fault-damage zones of white friable cataclasite occur in proximity to closely spaced strike-slip faults. These zones may represent internal deformation of the regional Cumberland Plateau overthrust.

7-04 Identifying additional convenience recycling locations in Putnam County, Tennessee. **Melissa Bilbrey* and Peter Li**, *Professional Science Master Program, and Earth Sciences, Tennessee Technological University, Cookeville, Tennessee*. Putnam county currently has eight locations for waste collection and recycling centers. When researching the population growth caused by real estate market growth of home and apartments a need was discovered. New manufacturing on the west side of the county has added jobs and to the current population. The students attending Tennessee Tech University also add to the challenge. New locations were identified to help fill this need. The study will use GIS processes to analyze population growth in the past decade, income and spatial analysis to locate new recycle centers for the City of Cookeville and probably Putnam County. Layers such as streets, community, land use, and demographic data are used for the processes. Results can be used for future planning purpose.

7-05 The effects of various demographic variables on the COVID-19 pandemic in Tennessee. **Stephen Clements* and Peter Li**, *Tennessee Technological University, Cookeville, Tennessee*. The *SARS-CoV-2* virus has had a major impact as it became a pandemic and swept through the world as COVID-19. Using data from the 5-year American Community Survey and the Tennessee Department of Health about the demographics of and COVID-19 effects in the counties of Tennessee, this project aims to determine if a number of demographic variables, including disability status, education, health insurance, household income, self-employment, household size, internet access, population density, senior population, and poverty have had an impact on factors of the pandemic, including the total number of cases, deaths, and vaccination rates. Due to the nature of a pandemic, several of these analyses are expected to show close associations, such as population density and case count, but others are more speculative – for instance, access to high-speed internet may impact a county's case count due to the ability of the population to participate in remote work and schooling.

7-06 Water quality and eutrophication in Tennessee State University's wetland. **Tyrese Stanford*, Jonathan Alford, De'Etra Young, and Tom Byl**, *Tennessee State University, Nashville, Tennessee (TS, JA, DY, TB), U.S. Geological Survey, Nashville, Tennessee (TB)*. The wetland at the Tennessee State University (TSU) research farm in Nashville, Tennessee, has been frequently overwhelmed by eutrophication and harmful algal blooms, posing a danger to livestock and wildlife. The objective of this research was to measure water chemistry, including microcystin toxin, to characterize the problem through time. Samples were collected at four locations in the TSU wetland between the summer of 2017 through the fall of 2021 and analyzed for nitrogen, phosphorous, iron, sulfur, Secchi depth, chlorophyll a, phycocyanin, and microcystin. Continuous water-quality instruments were also installed at the inlet and outlet of the wetland to document dissolved oxygen, pH, temperature, specific conductance, and turbidity. Microcystin concentrations ranged from less than 0.15 to 25.1 µg/L. Peak microcystin concentrations were well above the U.S. Environmental Protection Agency's health advisory concentration of 0.3 µg/L. Highest microcystin concentrations were located near a livestock access point.

Health & Medical Sciences and Microbiology Posters

8-01 Evaluating gene expression changes following exposure of different anti-malarial compounds. **Anna Gray*, Holly Hill, and Chris Barton**, *Belmont University, Nashville, Tennessee*. Colorectal cancer has relatively low survival rates. Current treatment options for this cancer still lack efficacy, so there is a demand for new and different drug therapies. There are multiple antimalarial drugs that show evidence of anti-cancer properties, and it has been shown that these molecules can reduce cell viability in colorectal cancer cells. However, the gene expression profiles of cells exposed to these molecules are largely unknown. Here, we analyzed gene expression profiles of multiple stress-related genes following exposure to two different antimalarial drugs, amodiaquine and tafenoquine. Our data suggest a set of altered genes that are common to both drug treatments, as well as some genes that are unique to only one. These data may provide useful as we continue to elucidate the mechanism by which these two drugs negatively affect the growth of cancer cells.

8-02 Tafenoquine reduces the efficacy of multiple chemotherapeutic compounds when used in multiagent therapy. **Hannah Moore* and Chris Barton**, *Belmont University, Nashville, Tennessee*. Cancer is a highly adaptive disease that is diagnosed in about a third of people during their lifetime. Drug repositioning is an effective and efficient way to explore treatments for existing drugs. Amodiaquine, an anti-malarial, has been shown to inhibit the growth of cancer cells and the ability to synergize with cellular starvation in melanoma cells. Our lab has shown a second drug, tafenoquine, is effective at blocking the growth of cancer cells. Here, we present data analyzing the ability of tafenoquine to function synergistically with a number of commonly-used chemotherapeutic compounds. These data will guide our future studies as we continue to analyze the role of antimalarial drugs as a part of different cancer therapeutic regimens.

8-03 Elimination of *Staphylococcus aureus* using mild elevated hydrostatic pressure and nisin. **Jyothi George and Aliyar Fouladkhah**, *Public Health Microbiology Laboratory, Tennessee State University, Nashville, Tennessee*. *Staphylococcus aureus* is one of the leading causes of healthcare associated infections in the United States and is an important cause of foodborne diseases in community. Food products are one of main reservoirs of this pathogen. Current study investigated effects of exposure to mild elevated hydrostatic pressure and hydrostatic pressure with nisin for inactivation of *Staphylococcus aureus* in buffered environment. Results of this study could be incorporated as a part of predictive public health microbiology modeling and risk assessment analyses for prevention of foodborne infection and toxicoinfection associated with *Staphylococcus aureus* and for meeting the regulatory requirements such as Food Code, HACCP, and Preventive Control for Human Foods rule of FSMA.

8-04 Anti-proliferative effects of tafenoquine on various cancer cell types. **Rylee Rickett* and Chris Barton**, *Belmont University, Nashville, Tennessee*. Drug repurposing is the act of using current FDA-approved medications for the treatment of different pathological conditions. Previous research has shown that a number of repurposed drugs are effective at preventing the growth of cancer cells, and some of these molecules are currently being studied in clinical cancer trials. Our laboratory previously found that amodiaquine, a drug typically used for the treatment of malaria, is effective at stopping the growth of cancer cells in culture. Whether other anti-malarial compounds are effective at preventing cancer growth has yet to be determined. Here, we show that an additional anti-malarial drug, tafenoquine, is effective at blocking the growth of multiple cancer cell types. We also show that tafenoquine, like amodiaquine, activates the activity of caspase enzymes. These data suggest that, like amodiaquine, tafenoquine is also activating an apoptotic pathway in cancer cells.

8-05 High-pressure pasteurization of *L. monocytogenes* in presence of nisin. **Sabrina Wadood and Aliyar Cyrus Fouladkhah***, *Public Health Microbiology Laboratory, Tennessee State University, Nashville, Tennessee*. *L. monocytogenes* is a Gram-positive pathogen of public health concerns that could infect children and adults of all ages. Infection with this bacterium is particularly concerning during pregnancy as pregnant women are nearly 10 times more likely to develop health complications when exposed to this pathogen. Six-strain mixture of *L. monocytogenes* were exposed to 0 to 9 minutes of elevated hydrostatic pressure treatments. Nisin alone at 5000 IU was not able ($P \geq 0.05$) to reduce the inoculated pathogen. Hydrostatic pressure alone at 350 MPa had limited ($P < 0.05$) efficacy for decontamination of the pathogen. Combination of nisin and 350 MPa pressure resulted ($P < 0.05$) in 2 to 5 log reductions of *L. monocytogenes*. Our results indicate that stakeholders of this emerging technology could benefit from utilization of nisin coupled with elevated hydrostatic pressure for further preventing the risk of infection with this ubiquitous pathogen.

8-06 Bacterial endospores as affected by elevated hydrostatic pressure. **Sadiye Aras and Aliyar Fouladkhah**, *Public Health Microbiology Laboratory, Tennessee State University, Nashville, Tennessee*. Validation studies for inactivation of microbial spores using pressure-based interventions could enhance the competitiveness and assure shelf-stability of pressure-treated commodities. Current study investigated synergism of heat and four antimicrobials for enhancing efficacy of elevated hydrostatic pressure treatments in deionized water and carrot juice for inactivation of three microbial spores currently considered as one of the most pressure-resistant natural isolates, the biological indicator for heat-based sterilization, and indicator for heat- and chemical-based decontamination interventions. Although spore suspensions were considerably more fastidious than microbial pathogens in planktonic stage in response to elevated hydrostatic pressure, up to >99% inactivation of the selected strains were observed when treatments were synergized with mild heat and a bactericidal and/or bacteriocin compound.

8-07 Effect of COVID-19 on the mental health of college students. **Viktoriya Marushka* and Pamela Hobbs**, *Lee University, Cleveland, Tennessee*. COVID-19 has impacted the world greatly, leading researchers to be interested in the virus's relation to mental health among various settings. Repeated isolation due to quarantining and virtual school created a change in academic approach for students across college campuses and is thought to have negatively influenced their mental health. This study anonymously surveyed students from Lee University on their mental health over the course of their COVID-19-influenced college experience regarding their motivation, sleep patterns, and physical activity. Results showed that about half of the students felt their academic motivation was affected by the pandemic. Additionally, almost half of the students scored in the moderate to severe range of depression, with a weak correlation to the number of hours slept or the inclusion of physical activity daily. These outcomes can provide small universities a better understanding of student experiences during COVID-19 to proactively meet the needs of students moving forward.

8-08 Conjugal transfer plasmid pDPT51 is bisymbiont comprised of two discrete replicons. **Austin Knight* and James Smart**, *University of Tennessee at Martin, Martin, Tennessee*. The broad-host range plasmid pDPT51 has been used for decades for horizontal transfer of ColEI replicons (pBluescript, pBR322, the pUC series, and derivatives thereof) to gram-negative bacteria. We present next-generation sequence data demonstrating that pDPT51 is in fact two separate contiguous DNA sequences, pDPT51α, and pDPT51β. BLAST analysis of each contig reveals that each bears an independent replication origin and antibiotic resistance marker: pDPT51α encodes an *oriV* ortholog as well as genes encoding resistance to trimethoprim and quaternary ammonium compounds. pDPT51β shares significant homology with pBR322 including a β-lactamase gene, a colchicine resistance protein, and the ColEI *ori*. We tested exconjugates bearing payloads mobilized by the pDPT51 system with PCR primers specific to both pDPT51α and β, demonstrating that both DNA elements are present in downstream hosts. This suggests that these DNA elements function as a bisymbiont rather than a transfer/helper system. The evolutionary significance of these results is discussed.

8-09 Occurrence of kanamycin-resistant bacteria along an urban hiking trail in Nashville, Tennessee. **Liz Bleyer*, Grace Hawkins*, Ashlynn Sherwood*, Rebecca Adams, Chris Barton and Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Increased use of antibiotics in humans and animals has contributed to a rise in antibiotic resistance, undermining the efficacy of antibiotic treatments. This study examines the relationship between antibiotic resistant bacteria in the soil microbiome and human activity. Bacteria resistant to kanamycin were isolated from soil samples collected at 12 sites located various distances from a hiking trail in Nashville, Tennessee in September 2021. Antibiotic resistant bacteria were found in all locations. Bacterial colonies were quantified and identified through PCR amplification and DNA barcoding. Microbial species diversity and abundance was correlated to soil pH, moisture, and proximity to the trail. Further research may identify the vector of resistance, specifically if the genes conferring resistance are incorporated into the bacterial genome or found on a plasmid. This research contributes to the general understanding of how human activity relates to antibiotic resistance in the soil microbiome.

History of Science Posters

No poster presentations

Mathematics & Computer Science Posters

No poster presentations

Physics & Astronomy Posters

9-01 Comparing structure and optical properties of bulk As2S3 glasses and amorphous thin films obtained by different technologies. **Anna K. Sheets*, Peyton D. Simpson*, James D. Forsythe*, Roman Holovchak, and Andriy Kovalskiy**, *Austin Peay State University, Clarksville, Tennessee*. Chalcogenide glasses are very promising materials due to number of useful properties such as infrared transparency, large refractive index, or large optical nonlinearity. Structure and optical transmission in UV-VIS region for bulk glass and thermally deposited or spin-coated amorphous thin films of stoichiometric As2S3 composition were studied. Confocal Raman microscopy was used to examine their molecular structure. The observed structural differences are explained by presence of “wrong” homopolar bonds in the thermally evaporated samples and participation of organic residuals in formation of spin-coated films. Changes in optical absorption edge are linked to the structural features. Optical band gap values were estimated from UV-VIS transmission spectra for the bulk glasses and thin films using PARAV software.

9-02 Examining the effects of UCN spectrum changes when determining the free neutron lifetime. **Garrett Krawczyk***, *Tennessee Technological University, Cookeville, Tennessee*. The lifetime of the neutron is an integral piece in understanding what was happening during the early evolution of our universe. At the Los Alamos Neutron Science Center, we can precisely measure the lifetime of neutrons using extremely low energy, roughly 100 nev, neutrons, called ultracold neutrons (UCNs). These UCNs are created by accelerating 800 Mev protons at a tungsten target. Spallation then occurs, allowing freed neutrons to be moderated by cooled plastic. These thermal neutrons are then converted to UCNs using a block of frozen deuterium. In order to measure the neutron lifetime, these UCNs are held in a gravitational and magnetic trap for several pre-programmed holding times. At the end of these holding times, a scintillation-based detector is used to count the remaining UCNs. When paired with several other scintillation-based detectors located in different regions of the experiment, we can normalize the disparity between differently performing UCN sources and determine the mean lifetime of UCNs in the trap. With loss mechanisms other than β-decay negligible, this is the free neutron lifetime. This poster will present the extraction of lifetimes from data collected using modified run conditions to study possible systematic errors within the experiment. The modifications studied here limit the energies of UCNs that can enter the experiment.

9-03 Fluorescence of Erbium Doped Bismuth-Borate Glasses. **Jacob Hannah*, Roman Holovchak, Andriy Kovalskiy, Jarres Plummer**, *Austin Peay State University, Clarksville, Tennessee*. Bismuth-Borate glasses are promising materials for various photonic applications. Doping with rare earth elements opens a range of entirely new possibilities for their use as active media in bright light sources, optical amplifiers, repeaters or energy conversion devices. In this work, the possibility of Er doping is investigated in Bi2O3 - B2O3 - Na2O system with different network modifiers (MgO, CaO, SrO). Fluorescent properties of these glasses are investigated in the near-IR region of optical spectrum, using Horiba Flurolog-3 spectrofluorimeter equipped with xenon short arc lamp as the light source. Excitation wavelength used was 270-800nm and 845-1800nm used for the emission spectra while utilizing liquid nitrogen-cooled Jobin Yvon InGaAs DSS-IGA020L detector. Fluorescence was observed in all Er doped samples at ~1550 nm wavelength. Intensity of this fluorescent line is shown to depend not only on the Er concentration, but also on the type of network modifier and Bi content in the composition.

9-04 Temperature dependence of photocurrent for mixed germanium-antimony-bismuth based thin films. **Killian Prue, Jarres Plummer, and Roman Golovchak**, *Austin Peay State University, Clarksville, Tennessee*. Electrical properties of germanium, antimony, and bismuth containing amorphous chalcogenide 1 micron thick films are studied at temperatures ranging from -100 oC – 150 oC while being exposed to light of varying wavelengths. For the non-modified S-Se-Te thin films, dark resistance decreases at increased temperatures, a property typical to semiconducting materials. Exposure of the samples to light results in a 40-95% reduction in their resistance as compared to dark, indicating dependence on the photon's energy. Increase in temperature results in a reduction of the photo-response of the initial material. It is noted that photo-response vanished at temperatures approaching the glass transition temperature. Through modification of the structure of the thin films with either Sb and/or Bi, the photosensitivity was extended into the NIR and IR regions of the spectrum. Introducing the heavy elements into the structure of the thin films resulted in a shift of the phonon spectrum to higher wavelengths.

9-05 Measurements and simulations of temperature-dependent optical transmission through nanoholes in a bilayer of gold and vanadium dioxide. **Zachary Givens and Eugenii U. Donev**, *Austin Peay State University, Clarksville, Tennessee*. Vanadium dioxide (VO2) switches between semiconducting and metallic phases near room temperature and its optical constants undergo large hysteretic changes. Light transmission through nanoscale holes in gold (Au) can greatly exceed the prediction of standard diffraction theory. We explore how the VO2 phase transition modulates this extraordinary optical transmission (EOT) in a bilayer of Au+VO2 films perforated by periodic hole arrays. We measured EOT spectra as a function of temperature through six arrays of different hole diameters and periodicities and constructed thermal hystereses for each wavelength. We observed EOT through Au+VO2 holes was higher for metallic-VO2, opposite to the behavior of the unperforated VO2 film. Simulations reproduce this 'reverse switching' and show the peak-transmission contrast between the two phases of VO2 depends sensitively on the geometrical parameters of the holes. Surprisingly, a prominent spectral feature measured at longer wavelengths does not exhibit reverse switching and remains to be explained.

Science and Math Teaching Posters

10-01 Development of 8 online micro-adaptive learning courses for dual enrollment and course sharing. **John C. Ricketts**, *Tennessee State University, Nashville, Tennessee*. The COVID-19 pandemic introduced many challenges for teachers and created a plethora of learning limitations for students. These challenges are exacerbated among underserved populations. Seemingly, distance education is the answer. However, teachers aren't equipped, online materials are stagnant, and the resources that are available do not include the critical STEM topics of food and agriculture. In response, we used USDA NIFA COVID-19 Rapid Response funding to develop 8 online micro-adaptive standards-based courses in Agriculture, Food, and Natural Resources for dual enrollment and course sharing. We recruited high school teachers through a min-grant process for content development. Selected teachers worked with instructional designers to develop the courses. Faculty mentors assisted with content questions and vetted curriculum for the college level. The eight courses are nearing completion and will be loaded onto a national course sharing platform (Quottly) so that students can use them at any institution where agreements have been reached.

Zoology Posters

11-01 Examining snapping shrimp morphology using geometric morphometrics in a phylogenetic framework. **Anchita Casaubon*, Carla Hurt, and Kristin Hultgren**, *Tennessee Technological University, Cookeville, Tennessee (AC, CH), and Seattle University, Seattle, Washington (KH)*. *Alpheus* snapping shrimps (ca. 331 spp.) comprise an ecologically diverse, species-rich genus that displays a tremendous amount of variation in key morphological characters. However, despite this dramatic variation in morphology, *Alpheus* is well-known for harboring numerous cryptic species complexes, many of which have been revealed only by molecular tools or subtle phenotypic differences. Our study uses geometric morphometrics in a phylogenetic framework to quantify the shapes of characters used in species diagnoses and identification. We digitized the major chelae and rostro-orbital hoods across species from the *Alpheus gracilipes* species complex to test the reliability of geometric morphometrics in species diagnosis. Additionally, we designed primers specific to *Alpheus* shrimp to amplify target gene regions for all shrimps (n = 7) in this species complex.

11-02 Cryptic variation and morphological diversity of *Faxonius placidus*, the bigclaw crayfish. **Parker Hildreth*, Carla Hurt, Jeff Simmons, and Carl Williams**, *Tennessee Technological University, Cookeville, Tennessee (PH,CH), Tennessee Valley Authority, Chattanooga, Tennessee (JS), Tennessee Wildlife Resources Agency, Morristown, Tennessee (CW)*. The Southeastern United States is the global center of crayfish diversity. Unfortunately, freshwater crayfish species are disappearing at an alarming rate; nearly 50% of North American species are currently threatened with extinction. Efforts to conserve crayfish diversity are impeded by a lack of information regarding the biological diversity of this group. The stream-dwelling crayfish *Faxonius placidus* (Hagen 1870), native to the Cumberland and Tennessee River drainages, is particularly problematic taxonomically as morphological characters useful for taxonomic identification are poorly defined. Consistent morphological and color differences between populations of *F. placidus* suggest that this species may include multiple, cryptic evolutionary lineages. Here we investigate relationships among populations of *F. placidus* using a combination of mitochondrial sequence data and qualitative observations on color patterns and morphology. A total evidence approach is used to identify evolutionarily distinct populations that may warrant taxonomic revision.

11-03 Molecular analysis of zoantharians located at the southernmost region of the Caribbean Sea. **Briley E. Bain*, Chloe E. Cummins*, S.G. Belford, Doug Dorer, and Shanna Hanes**, *University of Tennessee Southern, Pulaski, Tennessee.* Zoantharians are colonial cnidarians that are globally distributed throughout various tropical and subtropical marine ecosystem. Despite their high abundance and vital ecological role in these marine waters, few studies have accurately identified zoantharians in Trinidad, which is part of the southernmost part of the Caribbean Sea, where *Palythoa* and *Zoanthus* spp. are common. Morphological differences, such as oral disc and tentacle color have made identification of zoantharians difficult. We used molecular and phylogenetic analyses to gain a more comprehensive understanding of zoantharian diversity in Trinidad. We sequenced the mitochondrial 16S ribosomal DNA (16S rDNA) and cytochrome oxidase subunit I (COI) genes of zoantharian polyps collected from this region. Zoantharians were identified as *Zoanthus pulchellus*, *Zoanthus sociatus*, and *Palythoa caribaeorum* using both 16S and COI gene markers. Since molecular information regarding zoantharians in Trinidad is limited, further research is necessary to attain knowledge of zoantharian species diversity in this region.

11-04 Flyway use by bats in a northwestern Tennessee rural landscape. **Zachary Warren* and Nancy Buschhaus**, *University of Tennessee at Martin, Martin, Tennessee*. Understanding how bats use the landscape, such as flyways near large bodies of water, may help us to manage the landscape to increase the use by bats. The focus of our study was to determine whether bats preferentially use gravel road or mowed grass road habitats of similar width and cover type to reach a local water resource from a hardwood forest habitat. We hypothesized that there would be a difference between the two habitats, and we predicted that bats would prefer mowed roads. We used Wildlife Acoustics SM4 bat detectors placed in each flyway and near the water resource to record bat activity. We used SonoBat v.4.2 to quantify bat passes. We concluded that there was a significant difference in the bat use of these two flyway types.

11-05 Annual and elevational variation in bat activity and species richness at a stream in western Colorado. **Christina Medlen*, Howard Whiteman, and Nancy Buschhaus**, *University of Tennessee at Martin, Martin, Tennessee (CM, NB), High Lonesome Institute, De Beque, Colorado (HW), and Murray State University, Murray, Kentucky (HW)*. Bat populations in multiple states have been impacted by the advent of the fungus that causes White Nose Syndrome (WNS) in bats. Therefore, surveys of bat activity and species richness in those states that have not yet shown impacts due to WNS are vital. The focus of our study was to determine the bat activity and species richness at a third order stream in the Colorado Rocky Mountains. We hypothesized that there would be a difference in species assemblages and overall bat activity at two elevations. We predicted that species richness would be highest at the higher elevation site, but that bat activity would be highest at the lower elevation site. We used Wildlife Acoustics SM4 bat detectors to record bat passes and SonoBat v.4.2 to quantify bat passes. We concluded that there was significant variation in the bat use at these two sites both annually and by elevation.

11-06 The mechanosensory detection of flower petal angle of the proboscis of *Manduca sexta*. **Terry L. Newsome*, Emily Hudgins*, and Joaquin Goyret**, *University of Tennessee at Martin, Martin, Tennessee. Manduca sexta* is a large, crepuscular-nocturnal hawkmoth that forages for floral nectar, that locates flowers using olfactory and visual stimuli. When hovering at the flower, it uses the tactile sense of its proboscis to find the concealed nectar. Initially it taps on the floral corolla, exploring its surface. Upon detection of surface features, such as grooves or the nectary tube, it displays a back-and-forth flying pattern while dragging its proboscis on the flower's surface. We have used flat, 3D printed flowers with grooves of different widths and depths and found the spatial sensitivity of the proboscis lies between 0.05mm and 0.1mm. Here, we use conical surrogate flowers as proxy to quantitatively evaluate if a range of inclined surfaces will trigger the "back-and-forth" movement of the proboscis. We aim to find the minimum angle of a plane that moths can detect.

11-07 Discovering learned and innate sensory behavior of *Manduca sexta*. **Emily Hudgins*, Ben Allen, and Joaquin Goyret**, *University of Tennessee at Martin, Martin, Tennessee*. *Manduca sexta* are a large, crepuscular-nocturnal hawkmoth that utilize various sensory modalities while foraging for floral nectar. The location of floral nectar is aided primarily by the olfactory and visual stimuli offered by flowers. Nevertheless, it is known that nocturnal hawkmoths rely more on olfaction, and learn odors better than colors, while diurnal hawkmoths moths rely more on colors. Here, the crepuscular-nocturnal *Manduca sexta* are trained to learn between a rewarded feeder (yellow, honeysuckle-scented) from an unrewarded one (blue, bergamot-scented). After training, moths are tested to investigate if there is a sensory modality they learn better (color or odor). The first set of trials under diurnal illumination have been finished, and now we're starting to train and test the hawkmoths under nocturnal illuminations. The comparison of the two testing conditions will contribute to our understanding of whether hawkmoths are intrinsically flexible in their use of these sensory modalities.

11-08 Activity of ticks from various habitats and times of day, and corresponding infection status with *Borrelia* spp. and *Babesia* spp. **Emily S. Roark* and Barbara C. Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. Understanding tick phenology can help to prevent human infection, especially important as tick-transmitted diseases are on the rise in North America. This study examines the activity of ticks in Knox County, Tennessee from different times of day and habitat types as well as infection prevalence of *Borrelia* spp. and *Babesia* spp. Ticks were collected over a four-month period in three different habitats (short grass, tall grass, and wooded areas) at three times of day (morning, afternoon, and evening). Ticks were identified to species prior to DNA extraction: *Ixodes* spp. (n=2), *Dermacentor variabilis* (n=17), *Amblyomma americanum* (n=12). PCR is underway to screen ticks for *Borrelia* spp. and *Babesia* spp. Currently four (n=11, 36%) amplified *Babesia* spp. DNA. Statistics and positive amplicon sequencing are pending. These data contribute to our growing knowledge of tick natural history in Appalachia.

11-09 Piroplasms in the genera *Babesia*, *Theileria*, and *Cytauxzoon* from Ixodid Ticks in the Cumberland Gap Region. **Evan Collett* and Barbara Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. Piroplasms are tick-borne pathogens of mammals and birds in the genera *Babesia*, *Theileria*, and *Cytauxzoon*. This study investigates the diversity of piroplasms from Ixodid ticks in the Cumberland Gap region. We predict that *Babesia* will be the most prevalent piroplasm found in our study, and that piroplasm species will be correlated with tick species. We are screening Ixodid ticks for piroplasms via a PCRs that targets the ITS-1 rRNA and the 18S rRNA gene regions of piroplasms. Each of the four main tick species from the Cumberland Gap Region will be screened, i.e., *Rhipicephalus sanguineus*, *Ixodes scapularis*, *Dermacentor variabilis*, and *Amblyomma americanum*. So far, we have screened 391 *Dermacentor variabilis* ticks, and 45 ticks have positive amplicons (11.5%). *Dermacentor variabilis* is a vector of *Cytauxzoon felis*. Sequencing will be conducted to validate amplicons and determine species. These data contribute to the understanding of tick-transmitted diseases in rural Appalachia.

11-10 Prevalence and diversity of *Ehrlichia* spp. from Ixodid ticks in the Cumberland Gap Region of Tennessee, Kentucky, and Virginia. **Hannah F. Blevins* and Barbara C. Shock**, *Lincoln Memorial University, Harrogate, Tennessee*. *Ehrlichia* spp. are transmitted to animals and humans through the bite of an infected Ixodid tick, particularly bites from *Amblyomma americanum* and *Ixodes scapularis*. The main three species of *Ehrlichia* that affect humans in the United States are *E. ewingii*, *E. chaffeensis*, and *E. muris eauclairensis*; however, novel species continue to be discovered. Ehrlichiosis can result in fever, aches, nausea, as well as mortality. Humans, domestic animals, and wildlife are vulnerable to infection. This study will screen over 2900 tick DNA samples from the Cumberland Gap Area of Tennessee, Virginia, and Kentucky via polymerase chain reaction. These tick samples were collected from 2016-2020 and contain the genera *Ixodes*, *Amblyomma*, *Dermacentor*, and *Rhipicephalus*. Positive amplicons will be sequenced to determine the species of *Ehrlichia*. These data will contribute to our growing knowledge of tick-transmitted diseases in Appalachia as well as the diversity of *Ehrlichia* spp. in the United States.

11-11 Generation of a LM and SEM based copepod identification database and guide. **Lena Watson*, Stan Kunigelis, and LaRoy Brandt**, *Lincoln Memorial University, Harrogate, Tennessee*. Copepods are microscopic crustaceans found in most bodies of water, both marine and freshwater. They are heavily involved in the carbon cycle. Previous identification guides utilize pencil sketch drawings that minimally highlight the taxonomically important features to species identification. Although the sketches are often helpful, many times it is difficult to locate key characteristics on live and preserved specimens. To correct these shortcomings, this project was focused on light microscopy (LM) and scanning electron microscopy (SEM) images of calanoid copepods to highlight key identification characteristics. Once images were obtained, they were edited to highlight specific taxonomic features. In June 2021, copepods were collected from the Apalachicola Estuary off the coast of Florida. Collected specimens were preserved on site, and were returned to the Lincoln Memorial University Image and Analysis Center for processing and image acquisition. Species were identified and the images are currently being developed into a photographic identification guide.

TAS Standing Committees 2021

Auditing and Financial Oversight Committee

Dr. Tommy Wooten, Chair, Belmont University
Dr. Steven Murphree, ex-officio advisor, Belmont University

Education and Research Committee

Chair: Dr. Theresa Barke – Austin Peay State University, Clarksville Montgomery County School System
Dr. Linda Jordan - Science Consultant
Dr. Angela Cathey Malone - Columbia State University
Dr. Jennifer Mandel - University of Memphis
Dr. Alicja K. Lanfear - Middle Tennessee State University

Fellows Committee

Dr. Charles R. McGhee, Chair, Middle Tennessee State University (ret.)
Dr. Gladius Lewis, University of Memphis

Long Range Strategic Planning Committee

Chair: Dr. Darlene Panvini, Belmont University
Dr. Allyn Smith, Austin Peay State University
Dr. Fred Matthews - Austin Peay State University
Dr. Gilbert Pitts - Austin Peay State University
Dr. Kim Cleary Sadler - Middle Tennessee State University
Ms. Mandy Carter-Lowe - Columbia State Community College
Ms. Teresa Fulcher - Pellissippi State Community College
Dr. Karen Kendall-Fite - Columbia State Community College
Dr. Stephen Murphree - Belmont University
Dr. Dan Swartling - Tennessee Technological University

Membership Committee

Chair: Karen Kendall-Fite, Columbia State Community College
Dr. Gary Hall, David Lipscomb University
Dr. Jeffrey Lebkuecher, Austin Peay State University

Necrology Committee

Chair: Dr. Martin V. Stewart, Middle Tennessee State University

Nominating Committee

Chair: Dr. Darlene Panvini University
Dr. Allyn Smith, Austin Peay State University
Dr. Fred Matthews - Austin Peay State University
Dr. Gilbert Pitts - Austin Peay State University
Dr. Kim Cleary Sadler - Middle Tennessee State University
Ms. Mandy Carter-Lowe - Columbia State Community College
Dr. Cindi Smith-Walters - Middle Tennessee State University

Publicity Committee

Chair: Mandy Carter-Lowe, Columbia State Community College
Dr. Jeff Boles, Tennessee Technological University
Dr. Patricia Hull, Tennessee State University
Dr. Lewis Myles, Tennessee State University
Dr. Roger, D. Applegate, Tennessee Wildlife Resources Agency

Resolutions Committee

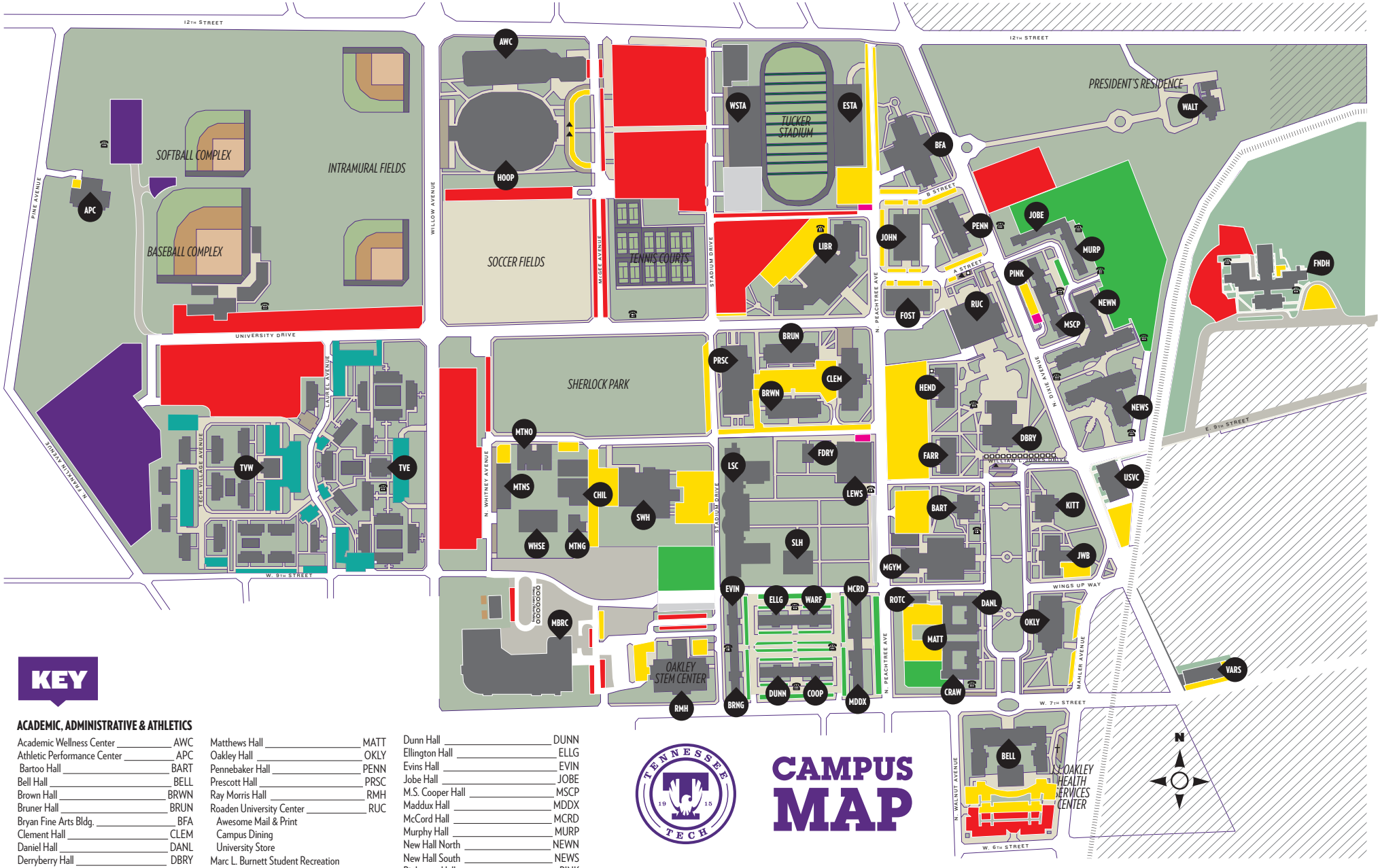
Chair: Dr. Preston MacDougall, Middle Tennessee State University
William H. Andrews, Jr., Oak Ridge National Laboratory, retired
Ms. Betty Davis, East Tennessee State University
Dr. David Pitts, University of Tennessee--Martin

Electronic Communications

Chair: Dr. Gilbert Pitts, Austin Peay State University
Karen Kendall-Fite, Chair, Columbia State Community College
Dr. Preston MacDougall, Middle Tennessee State University
Dr. Greg Vieira, Rhodes College

2021 TAS Executive Committee

President - Dr. Amy Thompson, thompsona@apsu.edu
President-Elect - Dr. Greg Vieira, vieirag@rhodes.edu
Past President - Dr. Darlene Panvini, darlene.panvini@belmont.edu
Secretary - Dr. Marcia Schilling, schillingm@apsu.edu
Treasurer - Dr. Steve Murphree, steve.murphree@belmont.edu
Managing Editor - Dr. Justin Oelgoetz, oelgoetzj@apsu.edu
Assistant Editor - VACANT
Collegiate Division Director – VACANT
Electronic Communications Director - Dr. Gilbert Pitts, pittsg@apsu.edu
Junior Academy Director - Dr. Preston MacDougall, preston.macdougall@mtsu.edu
Visiting Scientist Director - Dr. Tony Johnston, tony.johnston@mtsu.edu
Annual Meeting Coordinator - Dr. J. Allyn Smith, smithj@apsu.edu
Tennessee Science Liaison - Brian Caine, brian.caine@tn.gov
Chairperson Education – Dr. Theresa Barke, barket@apsu.edu
Chairperson Publicity - Ms. Mandy Carter-Lowe, mcarterlowe@columbiastate.edu
Member-at-Large 2019-2021 - Dr. Aruna Kilaru, kilaru@etsu.edu
Member-at-Large 2020-2022 - Dr. Nikki Glenn, nicole.glenn@belmont.edu
Member-at-Large 2021-2023 - Ms. Maryam Farsian, maryam.farsian@volstate.edu
AAAS Representative - Dr. Preston MacDougall, preston.macdougall@mtsu.edu
Membership Committee Chair - Karen Kendall-Fite, kkendallfite@columbiastate.edu
Necrology Committee Chair – Dr. Martin Stewart, martin.stewart@mtsu.edu



CAMPUS MAP

KEY

ACADEMIC, ADMINISTRATIVE & ATHLETICS

- Academic Wellness Center — AWC
- Athletic Performance Center — APC
- Bartoo Hall — BART
- Bell Hall — BELL
- Brown Hall — BRWN
- Bruner Hall — BRUN
- Bryan Fine Arts Bldg. — BFA
- Clement Hall — CLEM
- Daniel Hall — DANL
- Derryberry Hall — DBRY
- East Stadium — ESTA
- Farr, T.J. Bldg. — FARR
- Foster Hall — FOST
- Foundation Hall — FNDH
- Foundry — FDRY
- Health & Physical Education Bldg. — MGYM
- Henderson Hall — HEND
- Hooper Eblen Center — HOOP
- Jere Whitson Bldg. — JWB
- Johnson Hall — JOHN
- Kittrell Hall — KITT
- Laboratory Science Commons — LCS
- Lewis Hall — LEWS
- Matthews Hall — MATT
- Oakley Hall — OKLY
- Pennebaker Hall — PENN
- Prescott Hall — PRSC
- Ray Morris Hall — RMH
- Roaden University Center — RUC
  - Awesome Mail & Print
  - Campus Dining
  - University Store
- Marc L. Burnett Student Recreation and Fitness Center — MBRC
- Military Sciences — ROTC
- Southwest Hall — SWH
- Stonecipher Lecture Hall — SLH
- Varsity Building — VARS
- Volpe Library — LIBR
- Walton House — WALT
- West Stadium — WSTA

RESIDENCE HALLS & APARTMENTS

- Browning Hall — BRNG
- Cooper Hall — COOP
- Crawford Hall — CRAW
- Dunn Hall — DUNN
- Ellington Hall — ELLG
- Evins Hall — EVIN
- Jobe Hall — JOBE
- M.S. Cooper Hall — MSCP
- Maddux Hall — MDDX
- McCord Hall — MCRD
- Murphy Hall — MURP
- New Hall North — NEWN
- New Hall South — NEWS
- Pinkerton Hall — PINK
- Tech Village East — TVE
- Tech Village West — TVW
- Warf Hall — WARF

OPERATIONS

- Carr Bldg. — MTNS
- Carroll Bldg. — CHIL
- Facilities & Business Services Bldg. — MTNO
- Maintenance Garage — MTNG
- University Police — FNDH
- University Services Bldg. — USVC
- Warehouse — WHSE

PERIMETER PARKING
EMPLOYEE PREMIUM PARKING
TECH VILLAGE PARKING
RESIDENTIAL PARKING
STUDENT PREMIUM PARKING
MOTORCYCLE PARKING

- ○ Fitness Center 2 Hour Parking
- ☎ Emergency Phones
- Fire Lanes Are Marked
- □ Visitor Parking
- ▲ 30 Minute Parking
- † Health Services Parking