

Abstracts of Papers Presented at the 2016 Collegiate Meetings

Eastern Region

Pellissippi State Community College

Knoxville, Tennessee

22 April 2016

Fraser fir (*Abies fraseri*) reforestation in relation to ectomycorrhizal fungi in Great Smoky Mountains National Park. **Misty Nicole Branton*** and **Paul Threadgill**, *Maryville College, Maryville, Tennessee*. This study investigates Fraser fir reforestation through the interaction of seedlings with ectomycorrhizal fungi. Treatments were: nursery seedlings with no native soil or cocopads; nursery seedlings with native soil but no cocopads; nursery seedlings with cocopads but no native soil; nursery seedlings with both native soil and cocopads; wild seedlings with cocopads; wild seedlings with no cocopads. Seedling height and status were determined in June 2014, October 2014, May 2015, and October 2015. Data were analyzed using SPSS. One-way ANOVAs were performed on mean seedling heights in July 2014 and October 2015, and on change in height between June 2014 and October 2015. There was no difference in seedling heights between treatments in June 2014. Nursery seedlings with native soil and cocopads showed greatest positive change in height. Nursery seedlings with native soil and cocopads were significantly tallest in October 2015.

Human density and land-use effects on raccoon (*Procyon lotor*) anthropogenic food consumption near Chattanooga, Tennessee. **Andrew Mallinak***, **Lisa Muller**, and **Erin Patrick**, *The University of Tennessee, Knoxville, Tennessee*. Rabies is considered the most deadly infectious disease in the world if left untreated. Raccoon (*Procyon lotor*) rabies is currently considered the greatest threat in the United States and vaccination efforts have been ongoing since 1995. Urbanized areas are of particular interest given their high raccoon densities stemming from rich anthropogenic food sources. In order to target these areas effectively, the factors affecting raccoon anthropogenic food consumption must be understood. Using carbon and nitrogen stable isotopes from 241 raccoons trapped in a Tennessee vaccine-dispersed area, we examined the effects of land-use and human density upon raccoon human food consumption. The study found that the driving factors for consumption were individual weight and human population density for male raccoons,

while female consumption was driven by percent developed landcover and trapping area location. These results may signal a need for higher density vaccine dispersal in urbanized areas to ensure efficient vaccination and warrant further research.

Characterization of the silurian rockwood formation ironstone at Lauderback Ridge, South East Tennessee. **Jonathan C. Stanfield*** and **Habte G. Churnet**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Silurian fossiliferous ironstone deposits are found along the eastern USA, with at least six beds being located at Lauderback Ridge near Chattanooga, Tennessee. The initial focus of the research was to characterize the deposits based on observations in the field, thin section examination, and X-Ray Diffraction analyses in the laboratory. The ironstones are stratabound and present in the thicker basal beds of a series that is interbedded with thinning upward shale beds. Hematite and rhombohedral grains of ferroan dolomite and ankerite have replaced biomicrite. Based on paleomagnetic studies on the Silurian ironstone in Alabama, other researchers have inferred an Alleghanian age for iron mineralization. Additional research may further elucidate the overall objective of exploring the timing of iron mineralization.

Efforts to promote sustainable water consumption through education and blind water taste tests by Pellissippi State Student Affiliates of the American Chemical Society (SAACS). **Kristen M. Michaud***, **Kristen T Stratton***, **Nathan R Kaufman***, **Leslie Adamczyk** and **Rachel Glazener**, *Pellissippi State Community College, Knoxville, Tennessee*. Each year 5.35 billion pounds of polyethylene terephthalate (PET) are produced in the United States. To increase awareness regarding the inability of plastics to biodegrade, to educate students on sources of bottled water, and to encourage responsible bottled water consumption, the Student Affiliates of the American Chemical Society from Pellissippi State conducted blind water taste tests involving over 300 students in a 3 year period. Students were provided

with water samples of the following types: Brita™ filtered tap water, bottled Crystal Geyser™ spring water, Smartwater™ (enhanced with minerals), and local tap water. Students were asked to rank the water on taste. Results indicate that Brita™ filtered tap water and Smartwater™ were similarly strongly preferred. Bottled spring water was preferred by less than 9% of participants. Following the blind taste tests, students were provided with educational information on sources of bottled water, bottled water plastic types, waste, and recycling.

Survey of Tardigrades on moss in the Maryville College Woods. **Rachel F. White*** and **Paul Threadgill**, *Maryville College, Maryville, Tennessee*. This study investigated Tardigrade taxa present on moss in the Maryville College Woods, Maryville, TN. Collections were made from four sites in the Maryville College Woods on October 17, October 24, and October 30 2015. For each collection, date and moss environment were recorded and the moss was photographed. Moss samples were bagged and soaked in distilled water in petri dishes for twelve to twenty-four hours at room temperature in ambient light. After soaking, moss was squeezed by hand and removed from the water. Petri dishes were examined for Tardigrades using a stereomicroscope. Tardigrades were transferred to microscope slides and identified to Order using a compound microscope. Mosses were identified by Dr. Allen Risk of Morehead State University. Tardigrades in the Orders Macrobiotidae, Milnesiidae, and Hypsibiidae were found. It had been expected that the Orders Echiniscidae, Calohypsibiidae, Hypsibiidae, Macrobiotidae, and Milnesiidae would be present.

Survey of stream quality, macrobiota, microbial load and antibiotic resistance in waterways of Steele Creek Park. **MacKenzie LeMay***, **Cody Rogers***, **Marrienne Hull***, **Carrie Robinson***, **Cody Blankenship***, **Nicole Maldonado***, **Miranda Goodman***, and **Kelly Vaughan**, *King University, Bristol, Tennessee*. As the second largest municipal park in Tennessee, Steele Creek Park has an impact on the community of Bristol. However, there is still little information on the water quality and ecology of the Park's streams. In this study we conducted a survey of the three primary streams in the Park, investigating the quality and characteristics. In addition to a general overview of ecological characteristics, we also examined the chemical and microbial profiles of the streams. Due to the vastly different characteristics of the tributary streams, Steele Creek running through agricultural land and Mill Creek running along a busy road, we expected these differences to be seen in our data. We also conducted antibiotic testing on the bacteria that we found, particularly fecal coliforms, to assess the presence of antibiotic resistance in the waterways. The results of this ongoing study will help us to determine the health of Steele Creek Park.

Middle Region

Belmont University
Nashville, Tennessee
16 April 2016

Oral Presentations Chemistry

Ligand exchange reactions in a potential enzyme mimic copper(II) Schiff-base complex. **Caroline Williams***, **Spencer Colling**, and **Justin Stace**. *Belmont University, Nashville, Tennessee*. The synthesis, purification and characterization of a copper(II) Schiff-base complex: $[\text{Cu}(1,3\text{-dap})_2](\text{ClO}_4)_2$ (13dap = 1,3-diaminopropane), prepared in distilled methanol under an inert atmosphere, was studied. The product, which is highly soluble in water ($\lambda_{\text{max}} = 570 \text{ nm}$, $49.7 \text{ M}^{-1}\text{cm}^{-1}$) and acetonitrile ($\lambda_{\text{max}} = 568$, $57.1 \text{ M}^{-1}\text{cm}^{-1}$) was purified by recrystallization *via* diffusion of diethyl ether into a concentrated acetonitrile. The compound reacts rapidly as a ligand exchange reaction of chelating agents (oxalic acid and EDTA) in water and acetonitrile, and this reactivity may be a probe of the stability of the complex. These reactions are investigated with rapid mixing technique and the results discussed.

A kinetic study of the dependence of ascorbic acid concentration on temperature and time. **Ilyana R. Ilieva***, **Morgan L. Richardson***, and **Maria D. Garrett**. *Belmont University, Nashville, Tennessee*. Vitamin C, containing ascorbic acid, is a vital nutrient for the human body since it can prevent cardiovascular issues. As foods and drinks, especially juices, are a major source of Vitamin C, it is important to understand how processing techniques impact vitamin retention and degradation in food products. In this study, a series of back titrations were performed to determine how much ascorbic acid remains in flash pasteurized orange juice after being stored at 8°C, 23°C, and 40°C over 24-hour periods. Initially, the results showed ascorbic acid degradation followed zero order kinetics. However, further experimentation and data analysis showed a second order kinetic fit for the temperatures analyzed. Due to inconclusive results, arising from complications with the iodometric titration method, a new acid-base experiment is currently being developed. Completion of this new method will lead to a more accurate exploration of the kinetic behavior of ascorbic acid in orange juice.

Synthesis, characterization, and reactivity of various imine nickel(II) complexes. **Daniel Beagan***, **Jeannette Krause**, **Tasneem Siddiquee**, and **Justin Stace**. *Belmont University, Nashville, Tennessee (DB, JS)*, *University of Cincinnati, Cincinnati, Ohio (JK)*, *Tennessee State University, Nashville, Tennessee (TS)*. A nickel(II) complex, $[\text{Ni}(1,3\text{-dap})_3](\text{ClO}_4)_2$, was synthesized from $\text{Ni}(\text{ClO}_4)_2$ and 1,3-diaminopropane, yielding a purple crystalline product. With the addition of acetone, the $[\text{Ni}(1,3\text{-dap})_3](\text{ClO}_4)_2$ becomes $[\text{Ni}(1,3\text{-}$

dap2a)₂](ClO₄)₂, where (1,3-dap2a) = 2-aminopropane-1,3-diaminopropane, which is a yellow product. The [Ni(1,3-dap2a)₂](ClO₄)₂ product reacts with water to give a final blue product, [Ni(1,3-dap2a)₂(H₂O)₂]²⁺. The kinetics of the reaction of the yellow form to the blue form have been studied and analyzed, showing that there is at least one intermediate present. A mechanism is proposed for this reaction, indicating the change in geometry from square planar to octahedral. Cyclic voltammetry was performed on the three different complexes, providing insight into the redox potentials of the complexes. [Ni(1,3-dap)₃](ClO₄)₂ and [Ni(1,3-dap2a)₂](ClO₄)₂ were both reacted with oxalic acid, and in each case the oxalic acid underwent ligand exchange with the complexes. Crystallizations have been done to verify the structures of the different complexes, along with various IR and electronic spectroscopy.

Acid-base interactions mediate formation of the S100B-RAGE complex. **Rukiayah Warner***, **Kofi Amoah**, **Isis Christopher**, **Darlean Martin**, and **Steven Damo**, *Fisk University, Nashville, Tennessee (RW, KA, IC, DM, SD) and Vanderbilt University, Nashville, Tennessee (SD)*. A defining characteristic of Alzheimer's disease is the formation of amyloid plaques that elicit a signaling response resulting in chronic inflammation. RAGE is a multi-ligand single pass transmembrane protein receptor that is central to inflammatory complications in Alzheimer's. This project focuses on the interaction of RAGE with its activating ligand S100B. The overarching hypothesis is that the binding of S100B to RAGE results in an oligomeric complex that activates signal transduction. We used a computational docking approach to generate a model of the S100B-RAGE complex. The complex is stabilized by an acidic S100B surface interacting with the basic surface of the V domain of RAGE. In order to validate our model, we grew crystals of the S100B-RAGE complex that diffract to 9 Å. Together, these data represent important first steps towards understanding S100B-RAGE signaling in Alzheimer's disease.

Determination of the activation energy of the rate-limiting step of the Fenton reaction. **Libby A. Ligon***, **Parker H. Tumlin***, **Taylor Cohen***, and **Thomas Spence**, *Belmont University, Nashville, Tennessee*. The Fenton reaction is commonly used to remove polycyclic aromatic hydrocarbons from waste water streams. In this reaction, hydrogen peroxide and ferrous ions are thought to produce a highly reactive hydroxyl radical intermediate. However, the identity of the intermediate and the mechanism for this reaction are under dispute. Here, the rate of the Fenton reaction was studied under pseudo first-order conditions by allowing the reaction intermediate to convert benzoic acid to hydroxybenzoic acid and following the concentration of the product using fluorescence spectroscopy. The rate constant for this reaction was studied under pseudo first-order conditions at temperatures between 3°C and 25°C allowing for the determination of an Arrhenius activation energy of 38.8 kJ/mol.

Antioxidant activity in Matcha and leaf-brewed green teas. **Shekinah Baum*** and **Kimberlee Daus**, *Belmont University, Nashville, Tennessee*. Tea is the second most commonly consumed beverage. Green tea contains antioxidants known as polyphenolic flavonoid compounds that help reduce the damage caused by free radicals. Matcha, a form of green tea that has been historically popular in Asia, has recently grown in popularity in America. Matcha contains powdered green tea leaves; this allows the entire leaf to be ingested. Previous studies analyzed the antioxidant activity in leaf-brewed green teas, but have not studied the impact ingesting the entire leaf has on the antioxidant content. This research focused on comparing the antioxidant properties in matcha to those in a high quality green tea and a generic green tea. Assays to test the inhibition of DPPH[•] and ABTS^{•+} radical solutions were used to examine antioxidant activity in the tea samples. The data suggests that matcha contains higher antioxidant activity than an equivalent sample of either leaf-brewed tea.

Concise synthesis of 4H-Seleno[3,2-*b*]pyrrole toward its bio-transformation to [4,5]Selena-L-Tryptophan ([4,5]SeTrp). **Jacob Curry*** and **Duane Hatch**, *Belmont University, Nashville, TN*. L-tryptophan has been identified as a primary target for heavy atom amino acid derivatization due to low biological abundance as related to protein structure integration or catalytic activity. It may be utilized as an effective spectroscopic handle in order to elucidate the 3-D structure of the overall protein by multiwavelength anomalous diffraction (MAD) techniques. Recently, selenium-integrated tryptophan analogs have been synthesized by the Paulmier/Philips method, but in low yield. A proposed improved method by Boles/Silks to produce an isomer to the previously used [2,3-*b*]selenophene pyrrole, 4H-seleno[3,2-*b*]pyrrole, is explored in this scheme. This varied scheme is initiated by the bromination of a TIPS-labeled pyrrole, followed by a substitution of selenium, and produces high yields of the intermediate 4H-seleno[3,2-*b*]pyrrole.

Ligand exchange of an enzyme-mimic Schiff-base copper(II) complex. **Bailey Rose***, **Sarah Williams**, **Jeanette Krause**, and **Justin Stace**, *Belmont University, Nashville Tennessee (BR, SW, JS), and University of Cincinnati, Cincinnati, Ohio (JK)*. The synthesis, purification and characterization of a Copper(II) Schiff-base complex is presented. The [CuLN4](ClO₄)₂ complex (LN4 = *N,N'*-bis-(1-pyridin-2-yl-ethylidene)-propane-1,3-diamine) is highly soluble in acetonitrile, and moderately soluble in water, and exhibit Beer's Law behavior. The compound is unreactive in the presence of strong oxidizing agents, but does react slowly with oxalic acid. The reactivity of the complexes in aqueous solvent in the presence of oxalic acid is investigated. Rapid mixing of various concentrations of [CuLN4](ClO₄)₂ and oxalic acid monitored by UV-visible spectroscopy suggest an overall second order rate law. At greater time resolution, however, there is underlying complexity, suggesting a two step mechanism upon further analysis. The reaction seems to be

unaffected by exposure to the atmosphere. The solid produced is found to be copper(II) oxalate, and various mechanisms are investigated with their respective plausibility discussed.

It's raining, it's purifying: undergraduate research on water purification using a campus rain garden. **Kara Paden*** and **Kim Atwood**, Cumberland University, Lebanon, Tennessee. While rain gardens can be used for aesthetic appeal, they are also constructed to eliminate flooding and to clean groundwater by filtering out pollutants. The recent acquisition of a campus rain garden has permitted research on the water purification of filtering groundwater through the rain garden. Groundwater was sampled before entering the garden, as well as after it had filtered through the garden to find out if rain gardens do indeed remove pollutants. Results were conclusive with the hypothesis that there are less pollutants in groundwater after filtering through the rain garden. However, this research is in its early stages and doesn't have large amounts of data at this time.

Math/Computer Science/Physics

Testing techniques for finding Ramsey numbers of complete graphs. **Tucker Dowell***, Belmont University, Nashville, Tennessee. Ramsey theory is often first viewed in the form of a simple problem: finding the minimum number (called the Ramsey number) of people one would have to invite to a party to ensure there are either three mutual strangers or three mutual acquaintances. By using graphs, we are able to easily answer several variations of this question; however, there are still many open problems. When considering complete graphs (graphs where every vertex is connected to every other vertex), we only know nine Ramsey numbers! Finding Ramsey numbers has proven difficult, but we hope to benefit from a new approach. Join us in trying to view Ramsey numbers through a new lens.

The scintillator-layered imaging microscope for environmental research. **Gwendolyn Buchanan**, Tennessee Technological University, Cookeville, Tennessee. In microbial ecosystems, a high-throughput analysis can match microorganisms with the compounds they metabolize. This is a vital process, but the current tools are limited in both time and resolution. A new tool, SLIMER (the Scintillator-Layered Imaging Microscope for Environmental Research), will incorporate a thin-film microcolumnar cesium iodide (CsI) scintillator in a standard fluorescent microscope, to allow measurement of both fluorescence and radioactivity in a single step and to improve by a factor of 10 the resolution of current tools. In order to study the properties of SLIMER, a simulation to illustrate the topology of events was developed from the ground up with the GEANT4 toolkit. The simulation consists of CsI tubes, 1 μm in diameter, in a 1 cm by 1 cm array, with a ^{14}C source. The GEANT4 package for radioactive decay was used to model the decay of ^{14}C , and the package for optical photon processes was used to

realistically model the optics of scintillation. The HepRAPP Visualization Browser was used to provide a visual model of the scintillator, source, and particle tracks. The developed simulation provides useful information about the capabilities and properties of SLIMER, which in turn will impact the way microbial ecosystems and their impact on the environment are studied.

A predator-prey model for food-web in a lake. **Sharee Brewer***, **Ashely Davis*** and **Qingxia Li**, Fisk University, Nashville, Tennessee. Lake acidity affect organisms physiologically and can reduce their body size, reproduction capacity, egg viability and mortality rate. In this project, we developed a prototype system consisting of algae, an herbivore (daphnia), and a predator (pumpkinseed sunfish) and determined the coefficient functions governing dynamics of growth rate and death rate of organisms with respect to pH value in this system. Functions reflecting these relationships are obtained from experimental data in some references.

Gold nanoparticle synthesis comparison and lab activity development. **Christina A. King***, **Sarah A. Cannavino**, and **Davon W. Ferrara**, Belmont University, Nashville, Tennessee. The use of gold nanoparticles has become increasingly more prevalent in day to day life through their use as: conductors in electronics, catalysts, and being used to eradicate targeted tumors. To introduce students to nanoscience, a simple experiment is to compare the green tea method to the Turkevich method of gold nanoparticle synthesis using UV-Vis spectroscopy. This experiment will provide an introduction to both nanoscience and optics. One of the best, green reducing agents of the gold nanoparticles was determined to be black tea (amongst many other antioxidant containing food substances). By comparing these two methods through time resolved extinction spectroscopy and relatively inexpensive materials, a lab activity can be made for undergraduate, first year, chemistry and physics students as well as upper level high school students.

A case study in teaching Calculus I with economics model. **Howsikan Kugathan*** and **Qingxia Li**, Fisk University, Nashville, Tennessee. The objective of this presentation is to connect the real life problem with the underlying mathematics concept of finding local extrema through a case study, which is appropriate for Calculus I at the lower collegiate level or high school level. Applying case studies in teaching will increase student's interest in learning mathematics and then truly understand the meaning of the mathematics concepts. This case is about how a grandson to help his grandma making maximal revenue by selling granola at a farmer's market. It is an interrupted case with a three part scenario. The first part discusses the case that grandma will only sell granola in bags which causes the problem to calculate the profit with the first derivative test. The second scenario did pass the derivative test because grandma expanded her selling scale by selling the granola at any

weight. The third part will be involved with economics model of hiring a new grandma for this business. Through this process, students were also able to understand the mathematical and economical concepts clearly.

Visiomics: visualizing relationships among omics data. **Kofi Amoah***, **Jing Wang**, **Suhas Vasaikar**, **Steven Damo**, and **Bing Zhang**. *Fisk University, Nashville, Tennessee (KA, SD) and Vanderbilt University, Nashville, Tennessee (JW, SV, SD, BZ)*. Different factors such as genetic mutations and exposure to radiation can cause cancers, and several types of data can be collected from cancer studies. Since cancer is a disease of the genome it is necessary to understand the genomic, proteomic and clinical data pertaining to these cancers. About 100,000 attributes can be obtained from these datasets and about 5 billion pairwise associations can be made between these attributes. Considering such numbers, scientists may have difficulty understanding the datasets they study. Therefore a tool called LinkedOmics is being developed to conduct association analyses on the available cancer data from 3 cancer types: breast cancer, colorectal cancer and ovarian cancer. Visiomics, a features of LinkedOmics, allows the conversion of results of the association analyses into interactive visualizations. The scatterplots, boxplots, venn diagrams, heatmaps and survival curves that are generated will help them make new connections among genomic, proteomic and clinical attributes.

Health and Medical Sciences

Endogenous anandamides as anxiolytics in *Danio rerio*. **Brandy L. Sweet***, **Lori McGrew**, **Barbara Ward**, *Belmont University, Nashville, Tennessee*. Anxiety affects 40-million adults in the US, and the side effects of drug treatment options for anxiety disorders in particular, rival the symptoms of the anxiety. The side effects of the current drug treatments include but are not limited to insomnia, nausea and memory loss, whereas anxiety symptoms include but are not limited to nausea, difficulty sleeping, and difficulty concentrating. New drugs are under review as alternative anxiolytics. Endogenous anandamides target CB₁ and CB₂ cannabinoid receptors in the central and peripheral nervous systems and have been implicated as effective anxiolytics. *Danio rerio* (zebrafish) are increasingly effective in drug testing to determine the efficacy of anxiolytics, and they express CB₁ and CB₂ receptors like those found in humans. Here we evaluate the anxiolytic effects of the following endogenous anandamides: anandamide, NADA, noladin ether, and virodhamine trifluoroacetate. The endogenous anandamides at a 1:1000 concentration were ineffective as anxiolytics. There are trends of efficacy in the data, particularly for NADA, that suggest further evaluation of endogenous anandamides as anxiolytics in zebrafish.

The effect of infection on ATP levels: trial measurements of bioluminescence with SpectroVis_{Vernier}TM. **Parin B. Patel*** and **Nick Ragsdale**, *Belmont University, Nashville, Tennessee*.

Infection can affect the metabolism of cells in *Caenorhabditis elegans*. It has been seen in previous research that infection can stimulate ATP production; this is due to an increased demand for ATP in order to carry out immune responses. This increase in ATP levels occurs in the initial phase of infection, but as the infection progresses past 48 hours, ATP levels start to decline. In this experiment, *C. elegans* were infected with *Staphylococcus aureus* by being grown directly on the bacteria for 3 days. ATP levels were then measured, in vivo, through bioluminescence spectroscopy. Bioluminescence spectroscopy measured the absorbance of light from the worms in a SpectroVis Plus. The results were inconclusive. Due to this, the worms were placed under a microscope in order to detect bioluminescence, however no bioluminescence was observed.

The effects of stress due to an increased immune response on working memory in *Danio rerio*. **Lindsey K. Cheek***, **Lori McGrew**, *Belmont University, Nashville, Tennessee*. *Danio rerio* are a NIH model organism for neuroscience research because they have a nervous system similar to humans. *Danio rerio*'s cognitive abilities allow them to be trained and used to test working memory under a variety of experimental conditions. The purpose of this study is to further the understanding of how an immune response can influence working memory function. *Escherichia coli* was used to better understand the effects of stress due to an immune response on working memory. The adult Zebrafish were trained using color cues in a T-maze to learn right from wrong. After training, the Zebrafish were split into a control and treatment groups. The treatment group was given *E. coli* then tested in the T-maze to see if the stress caused by a compromised immune system affected working memory. This study showed that stress caused by increased immune system activity negatively affected working memory in Zebrafish.

Determining *C. elegans* attraction to cervical cancer to expand on the nematode scent detection test – a cancer screening system. **Parker H. Tumlin***, **Robert Grammer**, *Belmont University, Nashville, Tennessee*. *C. elegans* displays a positive chemotaxis to cancerous tissue secretions and a negative response to healthy tissue. Utilizing this behavior as a cancer screening system has been shown effective for colorectal, breast, and gastric cancers, however its effectiveness with cervical cancers has not yet been evaluated. The goal of this project is to determine whether *C. elegans* are attracted to HeLa cells, a cell line derived from a cervical cancer. A dose-response curve of *C. elegans* response to dilutions of HeLa cancer cell secretions was established, finding that the nematode displays a significant attraction to the millionth dilution of the secretions. These results imply that the nematode scent detection test would also be effective for cervical cancers.

Technological screen exposure's effect on *Danio rerio*'s development. **Samantha T Gould*** and **Lori McGrew**,

Belmont University, Nashville, Tennessee. Understanding screen exposure's effect on people should be prioritized in a society that spends more than seven hours each day staring at a screen. This study analyzed 150 zebrafish embryos and 39 zebrafish larvae, the only non-mammal NIH certified vertebrate with the ability to see color. These fish were separated into three groups: one group experienced consistent exposure to a computer screen playing cartoons, the second group only had computer screen exposure during their 14 hour light cycle, and the last group was a control group that lacked computer exposure. It was expected that larvae development would decrease the more the fish were exposed to a moving computer screen. The results demonstrated a significant negative correlation between television exposure and development at the initial two-week stages of embryonic life. More research should be conducted to determine whether these results are reproducible and to assess potential implications for humans.

Effects of tricyclic antidepressants on working memory in *Danio Rerio*. **Araceli Garland* and Lori McGrew.** *Belmont University, Nashville, Tennessee.* Zebrafish are a model organism for pharmacological studies because of their widely studied genome, similar neurophysiology to humans, and robust drug absorption. Tricyclic Antidepressants (TCAs) are a minimally prescribed antidepressant that have been largely replaced by Selective Serotonin Reuptake Inhibitors (SSRIs) and Selective Norepinephrine Reuptake Inhibitors (SNRIs), but are still prescribed in some cases of extreme psychological disorders. The link between TCAs, attention deficits, and memory disorders has been largely unstudied, but complaints of these ailments are often reported. This study sought to determine whether Zebrafish dosed with the TCA desipramine hydrochloride would show more working memory deficits than their control counterparts. It was hypothesized that dosed Zebrafish would choose the 'wrong' side more often in a T-maze after being trained using color cues. Furthermore, choice latency would be increased in dosed fish. Results of the study showed no significance, possibly due to a small sample size.

Effects of statin drugs on memory in *Danio rerio*. **Lindsey Dennis* and Lori McGrew,** *Belmont University, Nashville, Tennessee.* Ever since the FDA revised warning labels on statins, controversy about their effects on memory has ensued. This study aims to investigate the effects of simvastatin on memory in a different model organism, *Danio rerio*. One group of fish was treated with simvastatin, while another group acted as a control. All groups were trained and tested in a T-maze. Choice latency and accuracy were measured for all of the fish after treatment. It was expected that fish treated with simvastatin would have poorer choice accuracy and greater choice latency than control fish indicating an adverse effect on memory. Treated fish were observed to have poorer choice accuracy and decreased choice latency when compared to control fish, though these results were not statistically significant. Overall,

this study indicates trends that simvastatin may negatively affect memory and decrease choice latency.

The effects of green tea and red grape juice extract on zebrafish cognitive function. **Donald Hoyle* and Lori McGrew,** *Belmont University, Nashville, Tennessee.* Alzheimer's disease is a neurodegenerative disease characterized by dementia, or memory loss. Green tea extract and red grape juice have been shown to improve memory in some studies. This study was designed to determine whether these substances would improve memory in *Danio rerio*, or Zebrafish. To do this, Zebrafish were trained in a T-maze, in which choosing the correct side earns a reward, while the wrong side results in punishment. The frequency with which fish made the correct choice was used to assess memory. Fish treated with either grape juice or green tea were compared to untreated control fish. However, there was no significance between any of the groups, thus there is no evidence that green tea or red grape juice improve the memory of Zebrafish. This may have been due to the small sample size. Further studies should include a larger sample size and additional concentrations of the substances to ensure optimal dosing.

Effects of Triclosan exposure on embryonic development in zebrafish. **Melissa M. Wolf* and Lori McGrew,** *Belmont University, Nashville, Tennessee.* Zebrafish exhibit a range of characteristics that mimic vertebrate complexity, making the organism an ideal model for the study of human pathologies. Using zebrafish as a preliminary model, we can gain insight as to how chemicals that are ubiquitous in our environment have an impact on human health. Triclosan is an antimicrobial drug that has been used for the past thirty years in various household products. Due to inefficient filtering at wastewater treatment plants, triclosan cycles back into drinking water. Here, we test the hypothesis that sub-lethal levels of triclosan will influence normal development, sensory functioning, and working memory in zebrafish. Significant abnormalities were shown in the early embryonic stages and throughout development in treated groups. Unfortunately, technical difficulties inhibited adequate gathering of sensory function data from non-standardized j-turn methods. Working memory T-maze testing exhibited trends toward memory deficits; however, the sample size was too small to conclude significance.

Cellular and Molecular Biology

The effectiveness and precision of capillary assays for *Caenorhabditis elegans*. **Alyssa Tidwell* and Robert Grammer,** *Belmont University, Nashville, Tennessee.* Because of its availability and short lifespan, *Caenorhabditis elegans* is a model organism for research. The most commonly used method for chemotaxis assays for *C. elegans* has problems in reliability when it is pushed to provide more than semi-quantitative measurements. A pulled capillary assay avoids some of the problems of the plate assay. Using adult worms

and four different doses of benzaldehyde, both plate assays and pulled capillary assays were performed for each dose of benzaldehyde. A dose response curve was made for each to examine whether the capillary assay was more precise and efficient than the traditional plate assay. The current research found that the capillary assay was more efficient and precise than the plate assay at detecting repulsion, but less so at detecting attraction. The capillary assay was also found to be an overall more sensitive measure.

Caenorhabditis elegans and their habitats. **Jemeilise Guzman*** and **Robert Grammer**, Belmont University, Nashville, Tennessee. *Caenorhabditis elegans* is a nematode that is used in a wide variety of experiments in the biological field for research. *C. elegans* can eat a wide variety of microbes and yeast found in some soils, but it is still unknown whether *C. elegans* is actually attracted to natural soil or only the soil heavy with bacteria such as human made compost heaps or manure which is where they are found easily. In this experiment, to see if *C. elegans* is attracted to natural soil, chemotaxis assays were performed. Three samples of soil were gathered from three different locations and tested against their autoclaved counterparts and H₂O. The soil supernatant was also tested against H₂O. It was predicted that *C. elegans* would be attracted to the natural soil even if it is not rich in nutrients like the soil that *C. elegans* are usually found in. The results of the assays performed show that *C. elegans* is attracted to the soil, including some water soluble substances that are found in the supernatant.

The subcellular localization of the apoptosis signaling kinases ASK1 and ASK3 influence signalosome formation and composition in response to cellular stress. **Kathryn Hook^{1,2*}**, **Joel Federspiel⁷**, **Amy M. Palubinsky^{2,3,4}**, **Ama J. Winland⁵**, **Britney N. Lizama-Manibusan^{2,3,4}**, **Daniel C. Liebler⁷** and **BethAnn McLaughlin^{2,4,5,6}**, ¹Belmont University, Nashville, Tennessee, ²MTNSfN SERPENT Program, ³Vanderbilt Brain Institute, ⁴Neuroscience Graduate Group, ⁵J.B. Marshall Laboratory, Departments of ⁶Neurology, ⁷Pharmacology & ⁸Biochemistry, and Vanderbilt University Medical Center, Nashville, Tennessee. Apoptosis Signal-Regulating Kinase 1/2/3 (ASK) is a key sensor in the MAPK pathway that determines cellular responses to stressors including environmental toxins, and has been implicated in several disease states. Live cell imaging demonstrated that cell lines overexpressing each of the isoforms were morphologically indistinguishable from the parental HEK293 cell line. Baseline localization of each isoform, via ICC, remained unchanged. ASK1 and ASK2 were found to be cytosolic, and ASK3 was mitochondrial. Live cell imaging data suggests that after treatment, ASK1 OE caused cells to be more susceptible to HNE while cell lines overexpressing ASK3 were not as affected. ICC experiments demonstrate that with HNE treatment, ASK1 relocalizes to the nucleus while ASK3 cells maintain mitochondrial localization. The varying locations of these two ASK isoforms with treatment may explain the differences in susceptibility to stress noted

between these two cell lines. ASK2 lines are currently being analyzed under these same parameters.

Characterization of olfactory dependent behaviors in the Florida carpenter ant *Camponotus floridanus*. **Alexandra A. Ruff***, **Stephen D. Ferguson**, and **LJ Zwiebel**, Vanderbilt University, Nashville, Tennessee. The complex societal structure of eusocial insects is maintained and modulated by an insect's ability to sense and respond to a wide array of chemical cues derived from internal and external environments. Specifically, peripheral olfaction plays a vital role in nestmate recognition which is integral to maintaining colony cohesiveness. In that context, *C. floridanus* was used as a model system to study the role of olfaction in mediating intra-specific colony recognition and aggression via responses to colony-specific cuticular hydrocarbons (CHCs). In order to characterize the requirements for olfaction in these processes, a series of chemical hyper-stimulation and mechanical ablation behavioral bioassays were designed and carried out in the context of inter-colony aggression. In addition, aggression bioassays were conducted between the two distinct morphological castes within a colony (majors and minors) in order to assess behavioral distinctions between these castes which may be linked to differences in peripheral olfactory gene expression mediated via epigenetic alterations as has been identified for other behaviors such as foraging.

Appetite-stimulating effects of herbal root, *Gentiana lutea*, on *Caenorhabditis elegans*. **Sarah E. Trippett*** and **Robert Grammer**, Belmont University, Nashville, Tennessee. Though herbal remedies are widely popularized by modern culture, little scientific evidence exists to back up their claims. In particular, the herbal root, *Gentiana lutea*, has been said to cause appetite-stimulating effects in those who use it. In order to test these claims, the microscopic nematode, *Caenorhabditis elegans*, is washed with a solution of the root and then allowed to undergo a chemotaxis assay comparing its preferential response to its food source, *Escherichia coli*, versus deionized water. An appetite-stimulating effect was not found, as there was not a significant increase in nematode movement toward the food source compared against a control assay involving no wash with the root solution.

The addictive effects of nicotine on *Caenorhabditis elegans*. **Jud Wisdom*** and **Robert Grammer**, Belmont University, Nashville, Tennessee. The purpose of this experiment was to see if nicotine pretreated *C. elegans* will choose nicotine over *E. coli*, the most common food used in *C. elegans* research. *C. elegans* were pretreated with nicotine and placed on a chemotaxis assay plate with *E. coli* as a food source on one half of the plate and nicotine on the other half. *C. elegans* taxis towards the nicotine would support the purpose of my experiment and show that nicotine addiction can cause the *C. elegans* to choose the substance over survival. The results of my experiment show pretreated *C. elegans* respond

differently to the different pretreatment methods and that nicotine is an appetite suppressant. These findings could be beneficial in learning about how nicotine affects the human body since *C. elegans* are a model organism in biology. Further research is required to correlate *C. elegans* response to equivalent nicotine concentrations to humans.

Generation and characterization of the Proline108Serine single nucleotide polymorphism in the human serotonin 2C receptor. **Gerald Nwosu***, **Mia Krout**, **Quzonna Reed**, **Michael T. Ivy** and **Hugh M. Fentress**, *Tennessee State University, Nashville, Tennessee*. Serotonin (5-HT) is found in the central nervous system (CNS), gastrointestinal tract, and is actively taken up by blood platelets. 5-HT is a neurotransmitter in the CNS that plays a role in many physiological responses by binding to over 14 different receptor subtypes. The serotonin 2C (5-HT_{2C}) receptor is a seven-transmembrane spanning, G protein-coupled receptor that is found in the choroid plexus as well as the cortex, the limbic system, and the basal ganglia. The 5-HT_{2C} receptor plays a role in bodily functions such as hypolocomotion, neuronal excitability, spatial learning, appetite, and anxiety. Single nucleotide polymorphisms (SNPs) can lead to changes in protein sequence and, in some cases, altered activities, which can provide insights into critical structure-function relationships of a protein. Therefore, the purpose of the present study is to generate and characterize the functional consequences of a SNP in the human 5-HT_{2C} receptor, which substitutes a proline for a serine at the 108th (P108S) amino acid position. The P108S SNP was generated by PCR site directed mutagenesis. The cDNAs will be transfected into NIH 3T3 fibroblasts and/or HEK293 cells. The functional consequences of the P108S SNP in the 5-HT_{2C} receptor will be examined using immunofluorescence to assess the localization and expression of WT versus SNP receptors. Radioligand binding will be used to determine changes in binding affinities for ligands due to the SNP. G protein signaling will be examined by phosphoinositide (PI) hydrolysis and G protein-independent signaling by measuring phosphorylation of signal transducer and activator of transcription 3 (STAT3) via western blotting. Supported by NSF Grant HRD-1238723 to HMF.

The effects of increasing dosages of α -lipoic acid on the chemotaxis of *Caenorhabditis elegans* at adulthood. **Ambrose E. Rice*** and **Robert Grammer**, *Belmont University, Nashville, Tennessee*. *Caenorhabditis elegans*' chemotactic response to attractants has been shown to decline with age. Previous studies have shown that α -lipoic acid can increase the neural function and chemotaxis in older worms. Antioxidants at higher concentrations have shown to cause oxidative stress as prooxidants, which would lead to reverse effects on the chemotaxis index. In this study, *C. elegans* will be staged to ensure uniform age and treated with various dosages of α -lipoic acid until assayed at day five. Chemotaxis assays helped determine α -lipoic acid's effect on the worm's response to 2,3-Butanedione. Previous research by Hsu

showed that 25 μ M and 50 μ M α -lipoic acid treatments significantly increased the chemotaxis index when compared to untreated day five worms. This study will focus on using even higher concentration of α -lipoic acid to determine when α -lipoic acid becomes a prooxidant. This contributes to research concerning *C. elegans* aging and the roles of antioxidants as prooxidants.

Visiomics: visualizing relationships among omics data. **Saffron Little***, **Sashari Pinnacle**, **Anastacia Smith**, and **Steven Damo**. *Fisk University, Nashville, Tennessee (SL, SP, AS, SD) and Vanderbilt University, Nashville, Tennessee (SD)*. The antibiotic resistant pathogen *Staphylococcus aureus* represents a major threat to global health. Understanding the molecular mechanisms of *S. aureus* virulence will allow for the development of more effective therapeutics. This project focuses on the role of two manganese dependent enzymes, SODA and SODM, which are critical virulence factors of *S. aureus* that protect the pathogen from oxidative stress. We hypothesize that understanding the structure-function relationships of these enzymes will give insights to bacterial pathogenesis. In order to assess any structural differences between SODA and SODM, the thermodynamic stability of each protein was determined by measuring the intrinsic tryptophan fluorescence as a function of guanidine hydrochloride concentration. Our results demonstrate that SODM is more stable than SODA by about 1000 cal/mol. These studies will result in a complete biophysical characterization of SODA and SODM that will allow for a detailed analysis of their functions.

Western Region

Rhodes College

Memphis, Tennessee

2 April 2016

Oral Presentations

Comparison of serums used in cell culture to reduce research costs. **Miranda Anderson***, **Hilaire Playa Barch**, **Raya Krutilina** and **Tiffany N. Seagroves**, *Christian Brothers University, Department of Biology, Memphis, Tennessee (MA)*, and *Center for Cancer Research, Department of Pathology and Laboratory Medicine, University of Tennessee Health Science Center, Memphis, Tennessee (MA, HPB, RK, TNS)*. Cell culture is an integral part of cancer research. Cell lines are grown in media containing serum, a complex mixture of proteins, lipids and peptides that promotes cell viability and growth. The most commonly used serum supplement is fetal bovine serum (FBS). FBS prices have recently tripled, and a single bottle that may last only a few weeks now costs >\$500. As grant dollars awarded to researchers' continue to decline, a cost-efficient serum supplement is preferred. Newborn calf serum (NBCS) is a suggested replacement for FBS, and costs about 20-30% of the price of FBS. In this study, several breast cancer cell lines

(MDA-MB-231, MDA-MB-468, CAMA, MCF-7 and MDA-MB-453) were grown in either 10% FBS, 10% NBSCS, a 3:1 mixture of FBS:NBSCS, or a 1:1 mixture of FBS:NBSCS. Growth rates and morphology were compared over multiple passages to determine if cells experienced any adverse changes.

Anxiolytic effects by modulation of GABA_A receptors in the basolateral amygdala. **Chelsea Casaccia***, **Yudong Gao**, and **Scott Heldt**, *Christian Brothers University (CC) and University of Tennessee Health Science Center (YG, SH), Memphis, Tennessee*. GABA is an inhibitory neurotransmitter in the mammalian brain that acts on GABA type A (GABA_A) receptors. Different brain regions have various subtypes of GABA_A receptors, mediating different behaviors in the basolateral amygdala (BLA). For example, benzodiazepines clinically reduce anxiety by increasing GABA_A receptor action. It is not known which subtype(s) of GABA_A receptors in the BLA mediate the reduction of anxiety. We tested the hypothesis that activation of α 2- and/or α 3, but not α 1-subtypes in the BLA are sufficient, for mediating anxiolytic-like effects. In this study we activated different GABA_A subtypes by microinjections of various drugs into the BLA of wildtype mice and mice with genetic mutations deleting α 1-, α 2-, or α 3-subtype GABA_A receptors. Anxiety-like effects of mice were observed using behavioral testing. The results from this experiment showed the α 2- and α 3- subunits were sufficient in mediating benzodiazepine-induced anxiolysis, however, α 1 was not. Supported by the Crane Vision Fellowship.

Common motor phenotypes in mouse models of dystonia. **Madison R. Cobb***, **Jianfeng Xiao**, and **Mark S. LeDoux**, *University of Tennessee Health Science Center, Memphis, Tennessee (JX, ML) and Christian Brothers University, Memphis, Tennessee (MC)*. Missense mutations in CIZ1 were linked to autosomal-dominant dystonia. CIZ1 is a p21(Cip1/Waf1) interacting zinc finger protein that plays a role in DNA synthesis at the G1/S cell-cycle checkpoint. Missense and deletion mutations in SGCE were associated with the myoclonus-dystonia syndrome. SGCE encodes a cell-surface protein (ϵ -sarcoglycan) that contributes to dystrophin-glycoprotein complex in brain. Knock-out (KO) mouse models of Ciz1 and Sgce were characterized with a collection of motor tests including rotarod, grip strength, rope climbing, raised beam task, activity and DigiGait™. Both models reduced hindlimb stance widths and paw areas on gait analysis and increased slips on raised beam task. Modest differences in activity parameters were identified between KO mice and their WT littermates. These data suggest that the raised-beam task and gait analysis could be used as reliable motor readouts in pre-clinical studies of dystonia pharmacotherapeutics.

Projections from a CNS cardiovascular center to the superior salivatory nucleus that controls choroidal blood flow to the eye. **Rachel Depperschmidt***, **Matt Ennis**, **Malinda**

EC Fitzgerald, *Christian Brothers University, Memphis, Tennessee (RD, MF), University of Tennessee Health Science Center, Memphis, Tennessee (ME, MF)*. Projection pathways of the parasympathetic region of the seventh cranial nerve have been proven to receive input from hypothalamic regions and are thought to play a role in maintaining regulated choroidal blood flow (ChBF). This study investigated the potential projection pathway from the rat midbrain periaqueductal gray to the superior salivatory nucleus in effort to discover if the primary pain modulator could play a role in ChBF. Retrograde tracing techniques were used to double-label neurons which reveal that periaqueductal gray neurons terminate in contiguity to cholinergic neurons found in the superior salivatory nucleus. The present results suggest that the periaqueductal gray sends projections to the superior salivatory nucleus that could result in regulated ChBF in heightened times of pain during which systemic blood pressure is raised.

Identifying strains of *Escherichia coli* with Fourier transform infrared spectroscopy. **Alma L. Godoy***, **Tit-Yee Wong**, **Ying Sing Li**, **Ryan Parish**, *Christian Brothers University (AG) and The University of Memphis (TYW, YSL, RP), Memphis, Tennessee*. Identifying bacteria with accuracy and speed is an emerging research in clinical microbiology since some bacteria are a cause of infections and illnesses. Five strains of *Escherichia coli* and one strain of *Streptococcus* sp. were used to test if the Fourier Transformation-Infrared Spectroscopy (FT-IR) could be used to distinguish between these two species. The results from the vibrational absorbance spectrum showed these two species of bacteria absorbed IR at different wavelengths. There were notable differences between the two species within 700cm⁻¹-850cm⁻¹, at 1015cm⁻¹, and within 1650-1825cm⁻¹. Based on these preliminary results we concluded that, it is possible to use FT-IR to differentiate between different strains of bacteria.

BXD mice as possible suitable candidates for glaucoma research. **Joseph Krebs***, **Jimmy Wang**, and **Monica Jablonski**, *Christian Brothers University, Memphis, Tennessee (JK) and University of Tennessee Health Science Center, Memphis, Tennessee (JW, MJ)*. This study's purpose was to determine if some of the BXD mouse strains can be used as candidates to study of Primary Open Angle Glaucoma (POAG). POAG is a disease characterized by loss of peripheral vision without blockage or closure of the eye's drainage system. It is often accompanied by increased intraocular pressure (IOP). BXD mice are a family of recombinant inbred mice strains, some of which can display increased IOP. Specific genes have been identified in the human population which, when mutated, have a positive correlation with risk for developing POAG. These genes were then referenced with BXD data sets to find expression levels and number of polymorphisms. The genes were further investigated for mechanism of action and site of expression. Twenty-four genes were initially considered with only nine showing significant expression in BXD mice; TMCO1, ICA1, MYOC, TBK1, GMDS, ABCA1,

FNDC3B, EVOVL5 and GAS7 all showed significant expression.

Symplectomorphisms of algebraic torus invariant rings. **Ethan M. Lawler***, **Christopher Seaton**, and **Hans-Christian Herbig**, *Rhodes College, Memphis, Tennessee (EL, CS) and Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (H-CH)*. The phase space of a closed system consisting of a finite number of particles in classical mechanics can be completely described by an operation called the Poisson bracket. Some of these spaces arise from the invariant rings of an 1-dimensional algebraic torus acting on C^n . Using methods of Gröbner bases, we can compute structural information for an arbitrary torus invariant ring, such as the Hironaka decomposition, Hilbert series, Hilbert basis, and ideal of relations. Using different methods, we explicitly state the general form of the Hilbert basis and ideal of relations, as well as other structures for a large class of torus actions. We give theorems and proofs describing the algebraic and symplectic (Poisson) structure of a large class of invariant rings, as well as which give rise to symplectomorphic (Poisson isomorphic) systems.

Constraining conformation. **D.S. Magruder***, **L. Li**, **J. Uhruh**, and **K. Si**, *Rhodes College, Memphis, TN (DSM) and Stowers Institute for Medical Research, Kansas City, MO (LL, JU, KS)*. Prions' conformational dexterity makes their structure elusive. Crystallization cannot constrain prions to a uniform state and predictive software cannot handle the search space complexity. Pivotal in both memory and incurable diseases, discovering prions' mechanism of action is paramount. While failing independently, hybridizing biological and in silico assays may reveal structural insight of prions. Here we harmonize in silico and in vivo techniques to improve model accuracy by employing template-based modeling for known regions, application of split TEV protease to restrict conformation, and optimization techniques.

Genetic diversity and population structure in the clonal plant *Trillium recurvatum*. **Kendall Major***, **Dr. James Moore**, **Dr. Jennifer Mandel**, *The University of Memphis, Memphis, Tennessee (KM, JM)*, and *Christian Brothers University, Memphis, Tennessee (JM)*. *Trillium recurvatum* is a long-living clonal herbaceous perennial plant found in the central and eastern United States. Threats to this plant include: forest management practices, land-use conversion, and habitat fragmentation. *T. recurvatum* is self-incompatible so one genetic individual must be pollinated by a different genetic individual. *T. recurvatum* is clonal, so pollination could be difficult if there are few different genetic individuals in a specific region. In March 2014, 220 *T. recurvatum* leaf samples were collected from a population at the University of Memphis Meeman Biological Field Station. The DNA was extracted and stored at -80 degrees Celsius. PCR was performed on all 220 samples for 10 microsatellite loci. Five loci were pooled and run on a capillary electrophoresis. The

alleles were recorded using GeneMarker, and the data was analyzed using the GenAlEx software. 108 unique genotypes were found from 182 plants sampled, which means there is 60% diversity.

Influence of voluntary exercise on appetite and obesity in the paraventricular and arcuate nuclei. **Chandler Martin***, **Jesse Gammons**, **Alana Smith**, and **Kristen M.S. O'Connell**, *Christian Brothers University, Memphis, Tennessee (CM)*, and *The University of Tennessee Health Science Center, Memphis, Tennessee (CM, JG, AS, KO)*. The hypothalamic arcuate nucleus (ARH) is critically important for control of food intake and energy expenditure. Neuropeptide Y (NPY)/agouti-related peptide (AgRP) neurons in the ARH stimulate appetite and inhibit satiety-promoting pro-opiomelanocortin (POMC) neurons in the ARH and melanocortin neurons in the paraventricular nucleus of the hypothalamus (PVH). AgRP neurons project to the PVH to maintain an intricate negative feedback mechanism between appetite stimulation and inhibition, while astrocytes regulate neuronal function. In mice, consumption of high fat diet (HFD) decreases connectivity between ARH and PVH and activates astrocytes. Here, we labeled ARH and PVH to investigate if voluntary exercise (wheel running) could decrease, or even prevent, the loss of anatomical connectivity between ARH and PVH in mice. However, HFD induced astrocytic remodeling and loss of AgRP-immunoreactivity in mice with and without access to a running wheel, suggesting exercise was not effective at countering the neurodegenerative effects of a high-fat diet.

The effect of nephrotoxic drugs on fetal mesangial cell survival. **Katherinè Robinson***, **Theresa A. John**, **Hitesh Soni**, **Randal K. Buddington** and **Adebowale Adebisi**, *Department of Biology, Christian Brothers University, Memphis, TN (KR)*, *Department of Physiology, University of Tennessee Health Science Center, Memphis TN (TJ, HS, and AA)*, *Department of Health and Sport Science, University of Memphis, Memphis TN (RKB)*. Exposure of newborns to a variety of drugs may harm their kidneys. Drugs including antibiotics and anticancer agents administered to pregnant women and preterm newborns have been shown to inhibit kidney development. Glomerular mesangial cell (GMC) dysregulation is the hallmark of kidney dysfunction. However, the role of GMC dysregulation in the actions of nephrotoxic drugs is unresolved. In this study we examine the effects of gentamicin and doxorubicin on fetal GMC survival. Growth kinetics were studied in primary GMCs derived from preterm pig kidneys. Gentamicin (1-100 μ M) did not alter GMC growth up to 4 days. However, doxorubicin (1 nM – 10 μ M) inhibited GMC proliferation and induced GMC death in a concentration-dependent fashion. Doxorubicin also stimulated reactive oxygen species generation in the cells. These data suggest that gentamicin does not alter fetal GMC survival, while doxorubicin causes anti-proliferation and death by inducing oxidative stress. Supported by SRS Program UTHSC.

Multi-gate analysis of ultrasonic backscatter difference measurements on cancellous bone. **Phoebe Sharp***, **Brent Hoffmeister**, **Joseph McPherson**, **Peyton Marshall***, and **Ann Viano**, *Rhodes College, Memphis, Tennessee*. Ultrasonic backscatter difference techniques are being developed to detect changes in cancellous bone caused by osteoporosis. Backscatter difference measurements analyze the power difference between two or more gated portions of a backscatter signal. The goal of this study is to investigate how gate location and combination affect backscatter difference measurements of bone. Five consecutive one microsecond gates were placed on backscatter signals from bone. The power difference between different gate pairs was quantified using a parameter called normalized mean backscatter difference (nMBD). nMBD correlated most strongly with bone density for two gate pair choices: gates 1 and 3, and gates 1 and 4 ($R = 0.91$). Other choices produced significantly lower correlations ($R < 0.50$). We conclude that gate location and combination affect the correlation of ultrasonic backscatter difference measurements with bone density. This work was supported by NIH grant R15AR066900.

The effects of dopamine 1 and 2 agonists and antagonists on sexual and aggressive behaviors in male green anoles. **Alexis Smith*** and **David Kabelik**, *Rhodes College, Memphis, Tennessee*. Dopamine is a neurotransmitter that modulates social behaviors, and is conserved among vertebrates. Dopaminergic receptors of the D1 and D2 subtype are also conserved among taxa, and are involved in many different kinds of social behaviors, such as sexual and aggressive behaviors in mammals and birds. However, the functions of the receptors vary across taxa. In reptiles there have been two limited studies examining the relationship between the receptors and behaviors. This study examined the effects of D1 and D2 agonists and antagonists on sexual and aggressive behaviors in the male green anole lizard (*Anolis carolinensis*). Neither the agonists nor antagonists affected social behaviors. These findings differ from previous research, which demonstrated an effect of D1 and D2 agonists and antagonists on social behaviors in mammals and birds. A possibility is that the drug is binding to various regions in the brain that could have opposing effects on social behaviors.

Analysis of fecal glucocorticoid (FGM) concentrations in captive brown bears (*Ursus arctos*). **Alyssa Tews***, **Katrina Knott**, **Sarah Boyle**, and **Courtney Janney**, *Rhodes College, Memphis, Tennessee, Memphis Zoo, Department of Research and Conservation, Memphis, Tennessee, Animal Programs, Memphis Zoo, Memphis, Tennessee*. Concentrations of fecal glucocorticoid metabolites (FGM), a non-invasive indicator of physiological stress, were examined in two groups of adult captive brown bears ($n=5$, 6-7 aged years) to evaluate potential stress related to social group dynamics, husbandry conditions, and seasonal variation. Overall, FGM concentrations did not differ between groups; however, females

($85.16 \text{ ng/g} \pm 4.31 \text{ ng/g}$) showed higher ($P = 0.0037$) concentrations than the males ($71.32 \text{ ng/g} \pm 4.31 \text{ ng/g}$). Contrary to our hypothesis, FGM concentrations were not elevated among stereotypic or aggressive individuals compared to the behaviorally-normal animals. Continued longitudinal monitoring will assess seasonal variation and the impact of changes in housing that is planned for these animals. This study highlights the utility of monitoring FGMs better understand sources of physiological stress and thereby improve the welfare of captive ursids.

PGE2 mediates macrophage inflammatory cytokine response. **Ryan Tomlinson*** and **Richard A. Smith**, *Christian Brothers University, Memphis, Tennessee (RT) and University of Tennessee Health Science Center, Memphis, Tennessee (RAS)*. Wear debris produced from movement of prosthetic hips and knees may stimulate an inflammatory response from phagocytic macrophages that may cause periprosthetic bone destruction by a process called osteolysis. Tick saliva contains large amounts of Prostaglandin E2 (PGE₂) that aids in decreasing the inflammatory response of local cells during feeding by subverted macrophage secretion of proinflammatory mediators. Based on these findings we hypothesized that increasing PGE2 concentrations in culture with particle endotoxin-stimulated macrophages would decrease the inflammatory cytokines (TNF- α , IL-6) secretion and increase anti-inflammatory cytokine secretion (IL-10). Mouse IC-21 and human THP-1 macrophage cell lines were cultured with titanium particles and PGE2. Most IC-21 cytokines such as IL-1 α did not produce significant conclusive results; however, IC-21 and THP-1 TNF- α levels increased and THP-1 IL-10 levels decreased with increasing concentrations of PGE2. This study indicates a role for PGE2 in mediating inflammatory cytokine production by decreasing inflammatory and increasing anti-inflammatory cytokines.

Effects of alcohol on acute sleep deprivation in mice. **Ellie Vo***, **Jessica Baker**, **Kristin Hamre**, *Christian Brothers University (EV) and University of Tennessee Health Science Center (JB, KH), Memphis, Tennessee*. This study tested whether sleep deprivation altered the effects of ethanol using male and female mice of C57BL/6J and DBA/2J strains ($N=6$). Mice were sleep deprived for 4hrs or not. Ethanol-exposed were given IP injections of 20% EtOH (dose=1.5mg/kg) or isovolumetric saline. Five minutes post-injection, mice were placed into an elevated plus maze (5 min) and then the activity chamber (20 min) after. As expected, there were anxiolytic effects of ethanol in both apparatuses and sleep deprivation did not alter this. In the activity chamber, there was an enhancement of ethanol's stimulatory effects on locomotion in a sex- and strain- specific manner on certain measures. Sleep deprivation did not show any significant differences in saline-treated mice of either strain or sex. This shows that sleep deprivation can interact with ethanol's effects and it is possible that one would observe larger differences with a longer deprivation time interval.

The entropy of different tent maps. **Shuo Yan, Rhodes College, Memphis, Tennessee.** I am going to illustrate more and different kinds of tent maps. Build on the properties of regular tent map I explored before, I will talk more about the patterns of entropy of the tent map with different value μ and different maximum. The main focus will be how entropy of the tent map changes along with the change of slope and the location of maximum point. More specifically, my presentation will mainly focus on the lean to tent map, the pup tent map and the lean to pup tent map.

Poster Presentations

Aggressive behaviors between two female hippos (*Hippopotamus amphibius*) in captivity. **Erin Burman*, Annie Giarla*, and Samantha Ouyang*, Rhodes College, Memphis, Tennessee.** This project's purpose is to quantify agonistic behavior occurring between two hippos at the Memphis Zoo aiming to 1) identify patterns in the social interactions and dynamics between the two hippos, and 2) determine any behavioral changes due to a decreased available water space. We collected behavioral and spatial data using scan sampling at 2-minute intervals and determined an activity budget for each hippo. We quantified the proportion of time each hippo engaged in social behavior, noted the grid number for each animal at each interval, and recorded the water levels in each pool. The findings are important for quantifying the implications of spatial availability on the hippos' social relationships, and further determine how this relationship may change as new hippos arrive and the hippos move to a larger habitat.

Spatial and interactive data on captive meerkats of the Memphis Zoo. **Erica Carcelén*, Brooke Rose*, and Sarah Ferguson*, Rhodes College, Memphis, Tennessee.** Meerkats, *Suricata suricatta*, are gregarious mammals from southern Africa that live in genetically similar, altruistic colonies. At the beginning of this study the Memphis Zoo housed five meerkats (two females and three males), and currently only houses the three males. Aggression was prevalent when the five individuals lived in the colony, and the zoo requested a behavioral study on the social dynamics of the group. We analyzed spatial proximity and interactions between individuals before and after the removal of the females. We predicted that the males would show fewer aggressive interactions and closer spatial proximity toward each other after the females were removed. Additionally, we predicted that the two young males would be in closer proximity to their mother than the unrelated female in the colony. This is an ongoing project to monitor these social interactions as the colony faces future changes with the eventual introduction of new females.

Measuring active behavior in an aging African elephant (*Loxodonta africana*) in captivity. **Claire Carr* and Evan Tucker*, Rhodes College, Memphis, Tennessee.** African elephants may live around sixty years, though their aging process is not well understood. Tyranza, the Memphis Zoo's

fifty-one year old female African elephant, is the one of the oldest captive African elephants in North American zoos. The objective of this study was to determine whether Tyranza's active behaviors have decreased during the last four years, and whether temperature impacted her active behavior. Using an ethogram, Tyranza's behavior was recorded at two-minute intervals using the scan sampling method. The percent of time that Tyranza engaged in active behaviors was calculated to determine her overall activity level during the months of September (141 total hours) and February (186 total hours) over four years. The findings of this study will determine to what extent Tyranza's activity levels have fluctuated over time, and if temperature correlated with these fluctuations. These findings may be important for understanding activity levels and patterns of aging in captive elephants.

Vigilance in a captive herd of *Bison bison*. **Austyn Harriman*, Kelly Gaines*, and Lynda Miller, Christian Brothers University, Memphis, Tennessee.** An ethological study was conducted on the captive herd of American bison at Shelby Farms State Park. Due to lack of threats from natural predation, it was hypothesized that vigilance levels would be low. The largest percentage of the herd's time was spent in feeding, and only 16% of the time was dedicated to vigilance. Of the time spent vigilant, 73% was generalized vigilance, and only 27% was spent in active vigilance. When more animals were bedded, there was a higher percentage of vigilance in the non-bedded animals. Bison were more vigilant in the afternoon than in the morning. No relationship was found between number of juveniles in a group and proportion of vigilant group members. There was a weak relationship between the number in a group and the number of bison vigilant, suggesting that the benefit of collective vigilance does not have much of an impact on the herd.

Serotonin activity in the male brown anole (*Anolis sagrei*) after social behavior encounters. **Jacob Hartline*, Alexis Smith*, and David Kabelik, Rhodes College, Memphis, Tennessee.** The role of the neurotransmitter, serotonin (5-hydroxytryptamine), in social behavior regulation is not fully understood. While it has been shown to have an inhibitory effect on aggression in mammals, reptiles, and birds, much less is known about its effect on courtship. This study utilized immunohistochemistry to examine the colocalization of 5-HT and fos, an immediate early gene product and marker of neural activity, in brown anoles (*Anolis sagrei*) exposed to aggression, courtship, and control social interactions. Consistent with previous research, percent activation of 5-HT neurons was negatively correlated with frequency of aggressive behaviors. Interestingly, animals exposed to the courtship interaction showed significantly lower 5-HT neuron percent activation than controls, while those in the aggression interaction trended towards the same effect. This study is part of a larger study looking into the interaction of multiple neurotransmitter systems and their effect on target nodes of interest to the social behavior neural network.

Imaging ultra-luminous infrared galaxies with integral field spectroscopy. **Eleanor Hook*** and **David Rupke**, *Rhodes College, Memphis, Tennessee*. Integral Field Spectroscopy (IFS) is an astronomical technique that allows for collection of spectra across a field of view. This allows for the creation of a three-dimensional data cube, with two spatial dimensions representing the field of view and a third spectral dimension. This research focuses on data collected with the Integral Field Unit capabilities of the VIMOS instrument on ESO's Very Large Telescope, in which ULIRGs are shown as extended objects in the data cube. These galaxies are of interest because they are common at high- z and are triggered by major mergers. However, in order to construct a data cube, it is necessary to use a series of data reduction techniques to eliminate or reduce various effects on the spectrograph by the atmosphere and the instrument itself. This data reduction is the focus of my research.

Hemoparasitic infection prevalence in small mammals living in forest fragments in Paraguay. **Patrick Leavey III***, **Katharine Goebel***, **Alisha Patel**, **Aubrey Howard**, **Monali Lipman**, **Pastor Pérez-Estigarribia**, **Noé de la Sancha**, **Laura E. Luque**, and **Sarah Boyle**, *Rhodes College, Memphis, Tennessee (PL, KG, AP, AH, ML, SB)*, *Centro Multidisciplinario de Investigaciones Tecnológicas, Asuncion, Paraguay (PP)*, *Chicago State University, Chicago, Illinois (NL)*, *Texas Christian University, Fort Worth, Texas (LL)*. Parasite ecology can be affected by forest fragmentation. The purpose of this study was to characterize and compare the hemoparasitic infection prevalence in small mammals in relation to the size of their forest fragment habitat (six sampled fragments: 2-1200 ha) in the Tapytá Private Reserve, Paraguay. We collected blood samples from 134 individuals and then analyzed the slides from the specimens via light microscopy. Hemoparasitic infections were found in all six forest fragments and all four genera of small mammals captured. Of the individuals captured, 56.25% were healthy, while 43.75% were infected: 71.43% of *Gracilinanus*, 56.82% of *Oligoryzomys*, 51.85% of *Akodon*, and 50.00% of *Micoureus* were healthy. The most frequently observed infections were *Babesia* and bacterial infections including *Anaplasma* and *Mycoplasma*. By comparing infection rates with fragment size, we are able to explore relationships between forest fragmentation and parasite ecology within rainforest communities that may be applicable to other ecosystems.

Automorphism groups of k -star n -path saturated connected graphs. **Shushangxuan Li**, *Rhodes College, Memphis, Tennessee*. In this project, I will study a Ramsey-theoretic aspect of graph theory. The main question is: how many edges must a tree contain in order to guarantee the presence of a k -star or an n -path? Another way to think about this problem is: what is the maximum number of edges that a tree with no k -star or n -path can contain? We have established a general formula for the number of edges using induction and classified the trees that achieve this maximum. In addition,

we described the automorphism group of these saturated trees. The same questions are studied for connected graph following a similar studying procedure.

Land cover modification assessment for protected areas containing hippo study sites. **Brooke Rose**, *Rhodes College, Memphis, Tennessee*. Recent assessments show that common hippopotamus (*Hippopotamus amphibius*) numbers are declining, largely due to human impact. In order to better understand the role that protected areas (PAs) play in mitigating habitat modification, the current study compared land cover modification within PAs in which hippos have been studied and the surrounding 10 kilometer area around each PA. I found no difference between the percent land cover modification within the PAs and the surrounding areas. On average, both areas were comprised of less than 3% modified land cover, suggesting that the analyzed PAs have successfully mitigated land modification within their borders and in the surrounding 10 km area. Although these findings present a positive outlook for the common hippo's future, there were three PAs that showed high levels of modification. More research is needed to identify appropriate management solutions to ensure that natural habitat is preserved within these PAs.

Initial results from a COS Survey of PG Quasars. **Anthony To***, **David Rupke**, and **Sylvain Veilleux**. *Rhodes College, Memphis, Tennessee (AT, DR)* and *University of Maryland, College Park, Maryland (SV)*. We investigate 27 low-redshift ($z < 0.3$) quasars in the far ultraviolet with high signal-to-noise spectra from the Cosmic Origins Spectrograph on the Hubble Space Telescope. One quarter of these galaxies are found to have O VI (1032, 1038 Å) or N V (1239, 1243 Å) doublet absorption features, often with corresponding Ly α and Ly β absorption. Some of these profiles are indicative of outflowing, highly-ionized gas. We find both narrow and broad, blended features. We will present the results from preliminary fits of the absorption profiles.

Approaching Brownian-driven CARMA (2,1) process from CAR (1) process. **Shu Yang**, *Rhodes College, Memphis, Tennessee*. Continuous-time Autoregressive Moving Average (CARMA(p,q)) process is a stochastic model that is used to represent the trend of economics and financial markets. In this project, we specially focus on two lower degree CARMA processes: CARMA(2,1) and CARMA(1,0)(equivalent to CAR(1)). We proposed a theorem that CARMA(2,1) can be approached by two CAR(1) processes and worked on in passing some statistical properties from CAR(1) to CARMA(2,1). In particular, when a CAR(1) process is observed at discrete times, the unobserved driving Brownian motion can be approximated from the observed process and normality test can be conducted on the approximated increments of the driving process. Therefore, if CARMA(2,1) is observed at discrete times, we will be able to compute the same tasks by testing its equivalent of CAR(1) processes.