

*Tennessee  
Academy  
of  
Science*

**APRIL 2, 2016  
WESTERN REGIONAL  
COLLEGIATE MEETING**

Hosted by

**RHODES  
COLLEGE**

**Tennessee Academy of Science Western Regional Collegiate Meeting**  
Saturday, April 2, 2016  
Location: Rhodes College

Sponsored by:

Tennessee Academy of Science  
Rhodes College Department of Biology  
Rhodes College Department of Mathematics and Computer Science  
Rhodes College Environmental Studies and Sciences Program  
Rhodes College Biochemistry and Molecular Biology Program

Thank you to the following moderators and judges:

Malle Carrasco-Harris, University of Memphis  
Rachel Dunwell, Rhodes College  
Terry Hill, Rhodes College  
Rachel Jabaily, Rhodes College  
Carolyn Jaslow, Rhodes College  
Katrina Knott, Memphis Zoo  
Andrew Liu, University of Memphis  
Tara Massad, Rhodes College  
Jordan Meyer, Rhodes College  
Bashir Morshed, University of Memphis  
Mary Ogilvie, Christian Brothers University  
David Rupke, Rhodes College

Thank you to the Rhodes College βββ and Society for Physics Students for assistance with this event.

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*Cover artwork by Rhodes College student Aylen Mercado (class of 2019)*

**Keynote Speaker:**  
**Dr. Rachel S. Jabaily, Department of Biology,**  
**Rhodes College**

*Dr. Jabaily received a Bachelors in Science in Botany from University of Wyoming and Ph.D. in Botany from University of Wisconsin. She was a postdoctoral researcher at Old Dominion University in Virginia before joining the Rhodes College faculty in 2011. She has conducted fieldwork throughout the Andes, in Australia, and in China. At Rhodes College Dr. Jabaily teaches Evolution, Plant Genetics & Diversity, and Introductory Biology.*



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*Talk Title: “What’s in a name? Using molecular systematics to recognize new genera in *Goodenia* s.l., a clade of charismatic Australian wildflowers”*

*Abstract: Scientific names matter for the people using, studying, identifying, or conserving different biological groups. Species names and higher taxonomic groupings also serve as hypotheses of evolutionary relationships. The rapid increase in molecular sequencing abilities has put the goal of a full ‘tree of life’ connecting all biological groups within reach. These molecular ‘trees’, or phylogenies, often are in conflict with current naming systems, refuting the hypotheses of previous eras. The group *Goodenia* s.l. is a large (250+ species) and taxonomically diverse group of wildflowers primarily from western Australia, and previous research had indicated that the large genus *Goodenia* was not a singular group. My research team produced a nearly fully sampled, fully resolved phylogeny of *Goodenia* s.l., and use it to name new genera, place newly described species, and study the evolution of flower form. Support from next-generation sequencing data for multiple new genera is strong, and surprising patterns of floral symmetry invite further inquiry into evolutionary pressures.*

## Tennessee Academy of Science Western Regional Collegiate Meeting Schedule for Saturday, April 2, 2016

8:00 am	Registration begins (Location: Frazier Jelke Lobby)
8:15-9:00 am	Keynote Speaker: Dr. Rachel Jabaily (Location: Frazier Jelke B)
9:15-11:00 am	Sessions 1, 2, and 3 (please see below) Session 1: Biological Sciences (Location: Frazier Jelke A) Session 2: Health & Medical Sciences (Location: Frazier Jelke C) Session 3: Math and Physics (Location: Frazier Jelke D)
11-11:45 am	Poster Session (Location: Frazier Jelke Lobby)
12-1:00 pm	Lunch and Awards Ceremony (Location: The Refectory Dining Hall; Room: Hyde Hall)

### List of speakers and presentation titles for Sessions 1, 2, and 3. All three sessions start at 9:15 am.

#### **Session 1: Biological Sciences (Location: Frazier Jelke A)**

9:15 am	<b>Kendall Major</b> <i>Genetic diversity and population structure in the clonal plant <i>Trillium recurvatum</i>. Kendall Major, Dr. James Moore, Dr. Jennifer Mandel</i>
9:30 am	<b>Alyssa Tews</b> <i>Analysis of fecal glucocorticoid (FGM) concentrations in captive brown bears (<i>Ursus arctos</i>). Alyssa Tews, Katrina Knott, Sarah Boyle, and Courtney Janney</i>
9:45 am	<b>Alexis Smith</b> <i>The effects of dopamine 1 and 2 agonists and antagonists on sexual and aggressive behaviors in male green anoles. Alexis Smith and David Kabelik</i>
10:00 am	<b>Alma Godoy</b> <i>Identifying strains of <i>Escherichia coli</i> with Fourier transform infrared spectroscopy. Alma L. Godoy, Tit-Yee Wong, Ying Sing Li, Ryan Parish</i>
10:15 am	<b>Rachel Depperschmidt</b> <i>Projections from a CNS cardiovascular center to the superior salivatory nucleus that controls choroidal blood flow to the eye. Rachel Depperschmidt, Matt Ennis, Malinda E.C. Fitzgerald</i>
10:30 am	<b>Katherine Robinson</b> <i>The effect of nephrotoxic drugs on fetal mesangial cell survival. Katherine Robinson, Theresa A. John, Hitesh Soni, Randal K. Buddington and Adebowale Adebisi</i>
10:45 am	<b>Ryan Tomlinson</b> <i>PGE<sub>2</sub> mediates macrophage inflammatory cytokine response. Ryan Tomlinson and Richard A. Smith</i>

#### **Session 2: Health & Medical Sciences (Location: Frazier Jelke C)**

9:15 am	<b>Madison Cobb</b> <i>Common motor phenotypes in mouse models of dystonia. Madison R. Cobb, Jianfeng Xiao, and Mark S. LeDoux</i>
9:30 am	<b>Ben Tansey</b> <i>Optimum position of transthoracic line following cardiac surgery. James B. Tansey, TK Susheel Kumar, Saradha Subramanian, Mayte Figueroa, Mia McCoy, Anna Brauninger, Lindsey Bird, Jean A Ballweg, Shyam Sathanandam, Mohammed Al-Sheikh Ali, and Christopher Knott-Craig</i>
9:45 am	<b>Chelsea Casaccia</b> <i>Anxiolytic effects by modulation of GABA<sub>A</sub> receptors in the basolateral amygdala. Chelsea Casaccia, Yudong Gao, Scott Heldt.</i>

- 10:00 am **Chandler Martin**  
*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*
- 10:15 am **Ellie Vo**  
*Effects of alcohol on acute sleep deprivation in mice. Ellie Vo, Jessica Baker, Kristin Hamre*
- 10:30 am **Joseph Krebs**  
*BXD mice as possible suitable candidates for glaucoma research. Joseph Krebs, Jimmy Wang, and Monica Jablonski*
- 10:45 am **Miranda Anderson**  
*Comparison of serums used in cell culture to reduce research costs. Miranda Anderson, Hilaire Plya Barch, Raya Krutilina, and Tiffany N. Seagroves*

### **Session 3: Math and Physics (Location: Frazier Jelke D)**

- 9:15 am **Phoebe Sharp**  
*Multi-gate analysis of ultrasonic backscatter difference measurements on cancellous bone. Phoebe Sharp, Brent Hoffmeister, Joseph McPherson, Peyton Marshall, and Ann Viano*
- 9:30 am **Ethan Lawler**  
*Symplectomorphisms of algebraic torus invariant rings. Ethan M. Lawler, Christopher Seaton, and Hans-Christian Herbig*
- 9:45 am **Shuo Yan**  
*The entropy of different tent maps. Shuo Yan*
- 10:00 am **Daniel Magruder**  
*Constraining conformation. D.S. Magruder, L. Li, J. Uhruh, and K. Si*

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### **Poster Session: 11:00-11:45 am**

#### **Location: Frazier Jelke Lobby**

- P1 Imaging ultra-luminous infrared galaxies with integral field spectroscopy. **Eleanor Hook\***, David Rupke
- P2 Initial results from a COS survey of PG quasars. **Anthony To\***, David Rupke, and Sylvain Veilleux
- P3 Approaching Brownian-driven CARMA (2,1) process from CAR (1) process. **Shu Yang\***
- P4 Automorphism groups of k-star n-path saturated connected graphs. **Shushangxuan Li\***
- P5 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**, **Sarah Boyle**
- P6 An analysis of the prevalence of *Plasmodium*, *Leucocytozoon* and *Trypanosoma* sp. within raptors of the Mississippi Valley region. **Gizman Abdijabar\***, **Mary Crowell\***, **Michael Collins**, and **Jackie Denson**
- P7 Serotonin activity in the male brown anole (*Anolis sagrei*) after social behavior encounters. **Jacob Hartline\***, **Alexis Smith\***, and **David Kabelik**
- P8 Vigilance in a captive herd of *Bison bison*. **Austyn Harriman\***, **Kelly Gaines\***, and **Lynda Miller**
- P9 Measuring active behavior in an aging African elephant (*Loxodonta africana*) in captivity. **Claire Carr\*** and **Evan Tucker\***
- P10 Aggressive behaviors between two female hippos (*Hippopotamus amphibius*) in captivity. **Erin Burman\***, **Annie Giarla\***, and **Samantha Ouyang\***
- P11 Spatial and interactive data on captive meerkats of the Memphis Zoo. **Erica Carcelén\***, **Brooke Rose\***, and **Sarah Ferguson\***
- P12 Land cover modification assessment for protected areas containing hippo study sites. **Brooke Rose\***

## Abstracts

### Session 1: Frazier Jelke A

- 9:15 am: 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 GenAEx software. 108 unique genotypes were found from 182 plants sampled, which means there is 60% diversity.
- 9:30 am: Analysis of fecal glucocorticoid (FGM) concentrations in captive brown bears (*Ursus arctos*). **Alyssa Tews\***, **Katrina Knott**, **Sarah Boyle**, and **Courtney Janney**, *Rhodes College, Memphis, TN, Memphis Zoo, Department of Research and Conservation, Memphis, TN., Animal Programs, Memphis Zoo, Memphis, TN*. 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 ng/g  $\pm$  4.31 ng/g) showed higher ( $P = 0.0037$ ) concentrations than the males (71.32 ng/g  $\pm$  4.31 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.
- 9:45 am: 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.
- 10:00 am: 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<sup>-1</sup>-850cm<sup>-1</sup>, at 1015cm<sup>-1</sup>, and within 1650-1825cm<sup>-1</sup>. Based on these preliminary results we concluded that, it is possible to use FT-IR to differentiate between different strains of bacteria.

- 10:15 am: 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 heighten times of pain during which systemic blood pressure is raised.
- 10:30 am: The effect of nephrotoxic drugs on fetal mesangial cell survival. **Katherine 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  $\mu$ M) did not alter GMC growth up to 4 days. However, doxorubicin (1 nM – 10  $\mu$ 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.
- 10:45 am: PGE<sub>2</sub> 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 E<sub>2</sub> (PGE<sub>2</sub>) 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 PGE<sub>2</sub> concentrations in culture with particle endotoxin-stimulated macrophages would decrease the inflammatory cytokines (TNF- $\alpha$ , 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 PGE<sub>2</sub>. Most IC-21 cytokines such as IL-1 $\alpha$  did not produce significant conclusive results; however, IC-21 and THP-1 TNF- $\alpha$  levels increased and THP-1 IL-10 levels decreased with increasing concentrations of PGE<sub>2</sub>. This study indicates a role for PGE<sub>2</sub> in mediating inflammatory cytokine production by decreasing inflammatory and increasing anti-inflammatory cytokines.

## **Session 2: Frazier Jelke C**

- 9:15 am: 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 ( $\epsilon$ -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.
- 9:30 am: Optimum position of transthoracic line following cardiac surgery. **James B. Tansey\***, **TK Susheel Kumar**, **Saradha Subramanian**, **Mayte Figueroa**, **Mia McCoy**, **Anna Brauninger**, **Lindsey Bird**, **Jean A Ballweg**, **Shyam Sathanandam**, **Mohammed Al-Sheikh Ali**, and **Christopher Knott-Craig**, *Le Bonheur Children's Hospital, University of Tennessee Health Science Center, Memphis, Tennessee (TK, SS, MF, MM, AB, LB, JB, SS, MA, CK)*, and *Christian Brothers University, Memphis, Tennessee (JT)*. The transthoracic line has proven to be a safer alternative of central venous access for neonates due to prevalence of vessel obstruction in other approaches. Patients under the age of one that underwent cardiothoracic surgery were investigated to first see if a transthoracic line was used and if so what approach was used for central venous access. Transthoracic line has two different approaches with one being below the diaphragm (LTL) and the other being above the diaphragm (UTL). All complications and necessary data were obtained for each of the qualified patients in order to determine which approach provided the safest central venous access. The study showed that the UTL provided a safer approach due to the lack of complications that were seen in the LTL and other central venous approaches. UTL is a safer central venous access compared to LTL in the case of children under the age of one.
- 9:45 am: Anxiolytic effects by modulation of GABA<sub>A</sub> receptors in the basolateral amygdala. **Chelsea Casaccia\***, **Yudong Gao**, **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<sub>A</sub>) receptors. Different brain regions have various subtypes of GABA<sub>A</sub> receptors, mediating different behaviors in the basolateral amygdala (BLA). For example, benzodiazepines clinically reduce anxiety by increasing GABA<sub>A</sub> receptor action. It is not known which subtype(s) of GABA<sub>A</sub> receptors in the BLA mediate the reduction of anxiety. We tested the hypothesis that activation of  $\alpha$ 2- and/or  $\alpha$ 3, but not  $\alpha$ 1-subtypes in the BLA are sufficient, for mediating anxiolytic-like effects. In this study we activated different GABA<sub>A</sub> subtypes by microinjections of various drugs into the BLA of wildtype mice and mice with genetic mutations deleting  $\alpha$ 1-,  $\alpha$ 2-, or  $\alpha$ 3-subtype GABA<sub>A</sub> receptors. Anxiety-like effects of mice were observed using behavioral testing. The results from this experiment showed the  $\alpha$ 2- and  $\alpha$ 3- subunits were sufficient in mediating benzodiazepine-induced anxiolysis, however,  $\alpha$ 1 was not. Supported by the Crane Vision Fellowship.
- 10:00 am: 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.

- 10:15 am: 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.
- 10:30 am: 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.
- 10:45 am: 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% NBCS, a 3:1 mixture of FBS:NBCS, or a 1:1 mixture of FBS:NBCS. Growth rates and morphology were compared over multiple passages to determine if cells experienced any adverse changes.

### **Session 3: Frazier Jelke D**

- 9:15 am: 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.
- 9:30 am: 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  $l$ -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.
- 9:45 am: 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  $\mu$  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.
- 10:00 am: Constraining conformation. **D.S. Magruder\***, **L. Li**, **J. Uhrh**, 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.

## **Poster Session (Lobby): 11:00 – 11:45 am**

- Poster 1: Imaging ultra-luminous infrared galaxies with integral field spectroscopy. **Eleanor Hook\***, **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.
- Poster 2: 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  $\alpha$  and Ly  $\beta$  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.
- Poster 3: 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.
- Poster 4: 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.
- Poster 5: 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**, **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.

- Poster 6: An analysis of the prevalence of *Plasmodium*, *Leucocytozoan* and *Trypanosome* sp. within raptors of the Mississippi Valley Region. **Gizman Abdijabar\***, **Mary Crowell\***, **Michael Collins**, and **Jackie Denson**, *Rhodes College, Memphis, Tennessee*. Avian species are commonly infected by multiple parasites. The presence of parasitic protozoa within the blood has the potential to increase avian mortality as well as the potential to lead to a state of duress that can lead to injury to the animal. This study presents a survey of the prevalence of Plasmodium, Leucocytozoan, and Trypanosome specimens within a number of species of birds, with a particular focus on raptors undergoing rehabilitation from specimens collected within the immediate vicinity of Memphis, Tennessee. DNA was extracted from blood specimens and a variety of nested PCR reactions were performed in order to detect the overall prevalence and patterns of co-infections of these parasites within these populations. Samples exhibiting positive results were further analyzed through DNA sequencing and phylogenetic analysis for confirmation. The results and significance of this survey are presented and future directions of this course of study are discussed.
- Poster 7: 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.
- Poster 8: 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.
- Poster 9: 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.

- Poster 10: 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.
- Poster 11: 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.
- Poster 12: 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.