

Biology (and Biology related collaborations) student abstracts 2016

(Use the Ctrl + F keys to search for particular keywords or faculty)

Investigating Cell Cycle-specific Functions of the Sec7 Proteins in *Schizosaccharomyces pombe*

Adam Banks and Melanie Styers

The Sec7 proteins are a family of ARF-GEF proteins involved in the control of vesicular trafficking within the cell. The purpose of these experiments was to investigate the specific roles of the Sec7 proteins in the cell cycle and cytokinesis using fission yeast *S. pombe* as the model organism. Sequence analysis suggests that sec71p and sec72p, are homologs to the human BIG 1 and BIG 2 proteins. In order to investigate the roles of these proteins in the cell cycle, we analyzed the effects of deletion strains of *sec71Δ* and *sec72Δ* on septation, cell cycle progression, and cell viability. Calcofluor staining revealed no significant difference in septation between the strains but indicated that the *sec72Δ* strain tended to show a higher septation index compared to wild type and *sec71Δ*. This observation suggests that loss of *sec72* may slightly delay cytokinesis. A higher number of abnormal septa were present in the *sec71Δ* strain. Flow cytometry analysis of propidium iodide-stained cells revealed no significant differences in cell cycle profiles between the strains, but once again revealed that the *sec72Δ* strain tended to have a larger population of cells in G2/M. Analysis of cell viability assay revealed no steady state differences between the three strains, although our initial results suggest that the *sec71Δ* strain may exhibit resistance to hydrogen peroxide. This observation could link sec71p function to autophagic vacuolar transport, which has been shown to affect resistance to oxidative stress. Future studies will confirm and further explore this finding.

Proboscis Morphology as an Indicator of Flower Visitation of Moths

Wylie Bishop and Peter Van Zandt

Moths are believed to play a large role in pollination, however very little is known about the interactions between moths and plants due to their nocturnal lifestyle. The proboscis, or tongue, is thought to be specialized for the types of liquids the moths consume such as flower nectar, rotting fruit, or other plant exudates. I undertook this study of the differences in feeding structures of suspected flower visiting and non-flower visiting moths to see whether the feeding habits of moths can be related to proboscis morphology. I hypothesized that flower visiting moths have proboscis adaptations for drinking liquid through a narrow opening. Therefore, flower visiting moths should have a longer proboscis, a shorter tip region with few sensilla on it that are shorter in length, and a proboscis that tapers more gradually than non-nectar feeding species. Six traits (proboscis length, tip region length, sensilla length, number of sensilla, and proboscis thickness) were taken using a microscope mounted micrometer for 20 species of moths representing both flower visiting and non-visiting taxa. Most traits were found to not differ between groups; however, there was a trend observed for relative tip length to be shorter and for the rate of tapering along the proboscis to be greater in flower feeding species. The differences observed suggest that flower visiting moths may have some traits that are adapted for feeding in narrow tubes. Future studies should be conducted to further investigate whether or not these trends are seen across a broader range of species.

The Role of *lvs1* and *ypt4* in the Control of Vacuolar Size in *Schizosaccharomyces pombe*

Yorisha Bryant, David Schedler, and Melanie Styers

Chediak-Higashi Syndrome (CHS) is a rare childhood autosomal recessive disease diagnosed by the presence of enlarged or dysfunctional lysosomes. Mutation of *LYST*, a lysosomal trafficking protein in humans, has been shown to cause the disease. By studying the gene encoding this protein and characterizing its role in regulating lysosomal size, we can better understand the etiology of CHS and other lysosome-related diseases. Sequence analysis suggests that the fission yeast homolog of *LYST* is *lvs1*. We found that loss of *lvs1* or the Rab family gene *ypt4* results in enlarged vacuoles, the yeast equivalent of lysosomes. Although the function of *ypt4p* is unknown, Rab family members have previously been implicated in control of vesicle formation, fusion, and tethering. In this study, we first analyzed whether *lvs1p* and *ypt4p* indirectly influence vacuole size through alterations in membrane transport. Spot assays revealed that *lvs1Δ* and *ypt4Δ* strains exhibited no sensitivity to CaCl_2 or neutral pH, suggesting that membrane trafficking is not impaired in these strains. We also tested the hypothesis that these two genes work together in the same pathway to control vacuole size. FM4-64 staining of vacuoles in *lvs1Δ* and *ypt4Δ* strains revealed that overexpression of *lvs1p*, but not *ypt4p*, reversed the increase in vacuolar size, suggesting that these genes work in the same pathway and that *lvs1* is downstream of *ypt4*.

Effects of the solvent dimethyl sulfoxide (DMSO) on the anticancer ruthenium complex *trans*-[tetrachlorobis(1*H*-indazole)ruthenate(III)] (KP1019)

Anne Cetto, Laura Stultz, Pamela Hanson

Cancer is often treated using chemotherapy, and platinum-based drugs are a common class of chemotherapeutic agents. However, these drugs have many side effects so investigators have begun studying alternative metal-based compounds. Ruthenium compounds are a promising alternative, particularly indazolium *trans*-[tetrachlorobis(1*H*-indazole)ruthenate(III)] (KP1019). Although effective, KP1019 is limited by its low solubility. The purpose of this study was to investigate DMSO as an alternate solvent for KP1019 preparation. Through UV-Vis Spectrophotometry and cyclic voltammetry, solutions of the drug with and without DMSO were examined and resulting spectra were analyzed. Interpretations of data conclude that low concentrations (1-10%) of DMSO are a viable solution for combatting KP1019's low solubility while maintaining the drug's chemical integrity.

Habitat Preferences of an Invasive Crayfish (*Orconectes virilis*) and an Endangered fish (*Etheostoma nuchale*)

TJ Daugherty and Scot Duncan

The introduction of invasive exotic species is a major cause for loss of biodiversity in ecosystems. The Watercress Darter (*Etheostoma nuchale*) is an endemic, endangered fish that is present in only five springs throughout the greater Birmingham area. Roebuck Spring has the largest Watercress Darter population and this habitat has been invaded by the Northern Crayfish, *Orconectes virilis*. Invasive crayfish have been found to reduce native fish populations through predation and competition for food and shelter. *O. virilis* is suspected to prey on darters, and compete with them for food. Because crayfish, generally, are known to prefer sheltered environments, we hypothesize that they have similar preferences to the Watercress Darter. A previous study measured darter densities in the five most abundant habitats at Roebuck Spring. This study measures crayfish capture frequencies in these same habitats. Crayfish will be trapped over a period of 6 weeks during spring 2016. Traps are deployed for 48 hours, and then captured crayfish will be identified, sexed, and measured. Our lab has previously trapped this system. Therefore, this data will also be compared to and combined with trapping performed in previous seasons. This study aims to shed light on the impact the crayfish is having on darters, which could lead to necessary interventions.

Role of Hog1 Signal Transduction Pathway in Induction of the Drug Transporter Tpo1 in *Saccharomyces cerevisiae* Treated with the Anticancer Drug KP1019

McKenzie Davies and Pamela Hanson

Indazolium *trans*-[tetrachlorobis(1*H*-indazole)ruthenate (III)] (KP1019) is a promising ruthenium-based anticancer drug that stabilized disease progression in an early clinical trial. It could be an alternative to platinum-based chemotherapies currently in use, as KP1019 appears to cause fewer side effects. Although the drug's mechanism of action remains unclear, KP1019 has been shown to induce DNA damage in cancer cells, as well as the budding yeast *Saccharomyces cerevisiae*, which can serve as a model system for characterizing drug toxicity. Treatment of yeast with KP1019 activates the stress responsive kinase Hog1, which has a human homolog, p38 MAP kinase. Notably, p38 is also activated by anticancer treatments. Though Hog1's role in the response of *S. cerevisiae* to KP1019 is poorly studied, other stressors activate this kinase, which then activates the transcription factors Msn2 and Msn4. Preliminary data show that KP1019 treatment increases expression of the Msn2/4 targets *PDR5* and *TPO1*, which encode drug pumps that can facilitate drug resistance in yeast. To determine whether activation of Hog1 by KP1019 leads to upregulation of *PDR5* and *TPO1*, expression of Pdr5-GFP and Tpo1-GFP in yeast lacking Hog1, Msn2, Msn4, or both Msn2 and Msn4 was measured by flow cytometry. The results show that Hog1 and Msn2 deletions have reduced Tpo1 expression; data about Pdr5 expression were inconclusive. Although further study is required, preliminary data support the hypothesis that KP1019-dependent activation of Hog1 contributes to induction of Pdr5 and Tpo1, suggesting that therapeutics targeting the Hog1/p38 pathway may reduce inherent resistance to anticancer drugs.

The Role of Wildtype, *Sec71* Deletion, and *Sec72* Deletion Cells in Membrane Trafficking in *Schizosaccharomyces pombe*, as Determined by the Localization of Syb1.

Jamal Egbaria and Melanie Styers

ARFGEFs, such as BIG1 and BIG2, are proteins that play a role in membrane trafficking by exchanging a GDP for GTP and subsequently activating ARFs, which allow vesicles to be properly formed. The exact function of the human ARFGEFs, BIG1 and BIG2, is not known; however, it has been debated whether there is a compensatory relationship between these two proteins. It is hypothesized that BIG1 and BIG2 differ in function in some capacity. In order to determine if the ARFGEFs have distinct functions, Syb1, the model cargo for this experiment, was transformed into the yeast homolog of these ARFGEFs, *sec71* and *sec72*, and its localization was viewed using fluorescent microscopy. Preliminary data has shown that syb1 localizes to the cell surface in both the wildtype and *sec71* strains; however, there seems to be more syb1 localization in the endosomes in the *sec71* strain, which may suggest that *sec71* plays an important role in membrane trafficking. Additionally, wildtype strains expressing syb1 were strained with FM4-64 and treated with Brefeldin A, which is an ARFGEF inhibitor that will inhibit all ARFGEFs except for *sec71*. Any differences found in localization of syb1 may reflect the important role that *sec71* and/or *sec72* play in membrane trafficking.

Effect of Klotho Overexpression in Mouse Hippocampus

Jessica Froula, Stephanie Fox, Hai Vo, Melanie Styers, and Gwendalyn King

Age-related neurodegeneration is increasing in prevalence in our society. To develop novel therapeutics to treat neurodegenerative disease, greater understanding of the aging brain is required. One model for aging research is the Klotho (KL) mouse, which exhibits rapid aging and death when the KL protein is knocked out and an extended lifespan and enhanced cognition when it is overexpressed. Because little research exists to date about the KL overexpressor mouse (KLOE), we chose to focus on this model and compared the results with data from wild-type (WT) mice. Data in the lab suggest that KL is present in the synapse and published work suggests it is involved in synaptic transmission. To test whether KL affects structural plasticity, we used Sholl analysis to examine neuronal morphology in the CA1 region. Next, to determine whether changes in structural plasticity had functional outcomes, we performed behavioral assays to measure cognitive function in hippocampal-dependent tasks. KLOE mice showed changes in number of Sholl intersections and length at several Sholl radii compared to WT mice. They also showed enhanced spatial discrimination in both context-dependent fear conditioning and object-location memory tasks. These results show that KL affects memory functions and neuronal morphology. Learning neural mechanisms for how the brain declines with age will help determine ways to delay the onset of age-related diseases and dysfunction for the general population.

The effect of breath holding on respiratory sinus arrhythmia (RSA)

Kelsey Holdbrooks and Andrew Gannon

Respiratory Sinus Arrhythmia (RSA) is the naturally occurring increase in instantaneous (beat to beat) heart rate during inspiration and decrease of instantaneous heart rate during expiration. Previous studies have noted larger RSA values in children and young adults, particularly athletes. It has been hypothesized that the cause of RSA is pressure on the vagus nerve due to lung expansion during inspiration, which inhibits the parasympathetic influence of the vagus nerve, yielding an accelerated heart rate. The release of thoracic cavity pressure on the vagus nerve would then account for the decrease in heart rate during expiration. We examined the role of pressure on the vagus nerve in RSA by using breath holding trials. In collegiate athletes, instantaneous heart rate was significantly ($p < 0.01$) lower (72.30 ± 13.51 ; $n=20$) during breath holding with deflated lungs than with maximally inflated lungs (80.54 ± 13.841 ; $n=20$). This strongly supports the hypothesis that pressure on the vagus nerve due to lung inflation is the cause of RSA. The fact that instantaneous heart rate during breath holding with maximally inflated lungs was not statistically different from the instantaneous heart rate during the inspiratory phase of rhythmic breathing additionally supports that pressure on the vagus nerve is constant during breath holding. Because RSA has been proposed as an inexpensive technique to screen young athletes for cardiac health and predict by-pass surgery patients' survival probabilities, it is important to understand its cause.

Comparing the Population Density of Mosquitoes and Prevalence of West Nile Virus Along an Urban Gradient

Benjamin Carter Hunt and Pete Van Zandt

Mosquitoes transmit a variety of diseases, including West Nile Virus (WNV), however there is little surveillance on mosquitoes within the Birmingham area. There are four species of mosquitoes in Birmingham that are competent vectors for WNV: *Culex quinquefasciatus*, *Culex restuans*, *Aedes albopictus*, and *Aedes japonicus*. The purpose of this study was to determine the relative abundance of these vector species in the Birmingham area and the prevalence of WNV in these mosquito populations. Three collection sites were set up following an urban to rural gradient; the urban site was Birmingham Southern College (BSC), the intermediate site was Ruffner Mountain Nature Preserve (RMNP), and the rural site was Turkey Creek Nature Preserve (TCNP). I expected that urban mosquito populations would be larger than more rural populations and have a higher prevalence of WNV, due to the higher amount of breeding sites in cities. CDC gravid traps were used to capture mosquitoes during the evening, twice a week, from July 7th to August 4th. After identification, genetic pools consisting of like species from the same site were created and tested for WNV using VectorTest® Antigen Assay Strips. *Aedes albopictus* was found to be 32.5 times more abundant at BSC when compared to TCNP. No other species were caught in high enough numbers to allow statistical comparison. Antigen assays did not yield a single positive result for WNV. My results suggest humans are more likely to be bitten by vector competent species in urban habitats, which could increase the likelihood of WNV infection.

Effect of Social Influences and Dietary Intake on Body Mass Index

Claire Jones, Peter VanZandt, and Susan Davies

Obesity is a growing concern in the United States because of its increasing prevalence and capability to cause life-threatening diseases among those it affects. Obesity is a preventable condition but the causes and trends must be better understood to develop effective interventions. This study aims to identify trends among young adults for body mass index (BMI) in relation to dietary choices and social influences. We surveyed students from Birmingham-Southern College (BSC) and from disadvantaged inner-city communities on the social influences of their peer groups, nutritional intake and physical activity and also measured the height and weight for each participant to calculate BMI. For social influences, peer discouragement of tobacco use was linked to a lower BMI in the BSC population and peer encouragement of alcohol consumption was linked to a lower BMI in the inner-city young adults. In both populations, a higher exercise frequency was associated with a higher BMI. Additionally, in the inner-city population, binge eating and eating less food and calories was associated with a higher BMI. Overall, social influences had a relatively small influence on BMI in each group. However, for dietary choices and physical activity, we observed interesting and unexpected trends, such as the association between exercising more often/eating less and a higher BMI. This information can be helpful in designing better weight management programs but additional research is also necessary to determine the reason for these unexpected correlations.

Experiments on the Effects of Aposematic Coloration of Salamanders on Avian Predators Using Clay Models

Samantha Manzo and Megan Gibbons

Many organisms use anti-predator defenses, such as aposematic coloration, as protection from potential predators. Aposematic coloration is conspicuous coloration or patterns that generally function as an advertisement of unpalatability or noxiousness; however, few studies have experimentally validated predator avoidance of aposematic prey. Salamanders, including the toxic Red-Spotted Newt (*Notophthalmus viridescens*) are abundant in the Southeastern United States and basic knowledge of their ecological role is important for understanding how ecosystems function. A controlled field test was conducted using clay models to resemble the brightly colored (orange) red eft of *N. viridescens* and a common non-aposematically colored species, the Northern zigzag salamander (*Plethodon dorsalis*) to test if aposematism is an effective deterrent to avian predators. I hypothesized that the bright coloration of the eft stage of the Eastern Red-Spotted Newt is an aposematic signal to potential predators. I expected that if aposematic coloration reduces predation, then brightly colored models would have fewer occurrences of avian attacks than non-aposematic colored models. Models were placed at Ruffner Mountain for 48 hr and marks of predators were analyzed. When all predators were included in the analysis, predation rates on brown models were almost twice that of orange models, and this difference was maintained even when including only avian attacks, demonstrating that predators avoided brightly colored salamander models. Insects accounted for the most attacks on the models, followed by mammals, then birds. The results provide evidence for the hypothesis that bright coloration functions as a warning signal to potential predators.

Could a Prior Ankle Sprain Cause an Anterior Cruciate Ligament Tear?

John Massey and Jason Heaton

Anterior Cruciate Ligament (ACL) repair surgery and ankle sprains are both common; yet, little research has been done to associate these two injuries. It is thought that after ankle sprains occur, the biomechanics of the lower limb are altered, changing the weight-bearing mechanism of the ACL. We hypothesize that if ankle sprains increase the likelihood of tearing the ACL, then a substantial portion of patients undergoing ACL reparative surgery will have had more preceding ankle sprains in comparison to individuals who have not torn their ACL. As a means to study this potential association of ACL tears with ankle sprains, this study surveyed patients who were in physical therapy rehabilitation for demographic information as well as their musculoskeletal/ankle injury history. Variables, such as height, weight, sex, age, race, and the level of physical activity were collected. By statistically comparing the number of ankle sprains in the group without ACL tears to the group with ACL tears, it can be determined if ankle sprains serve as a precursor to ACL tears. Preliminary statistical analysis shows that females with previous ankle sprains are more likely to have an ACL injury; however, the finding was insignificant ($p=0.08$). No trend was shown in neither females with no previous ankle sprains nor males, with or without ankle sprains.

Comparison of Prevalence of Common West Nile Virus Mosquito Vectors in Urban and Rural Residential Sites

Austin Mills and Peter Van Zandt

Mosquitos are the most prominent vectors for insect-borne diseases such as Zika Virus, West Nile Virus, Chickungunya, etc. West Nile Virus has infected over 30,000 people in the United States alone. *Culex restuans*, *Culex quinquefasciatus*, and *Aedes albopictus* are common in the Southeastern US, and have all been identified as key vectors for the disease. Urban development results in a vastly altered matrix of artificial breeding sites for mosquitos. Previous research has indicated that storm water drainage structures, litter, housing construction, increased feeding opportunity, etc. are all associated with increases in mosquito abundance. Thus, since all of these factors are found in greater numbers in urban areas, it was expected that urbanicity would lead to an increase in species in the abundance of these species. Gravid mosquito traps were placed at three urban locations and two rural locations. The two *Culex* sp. were found in greater abundance at urban residential sites ($p = 0.005$ and 0.008). No significant difference was found for *A. albopictus*, but the total number of mosquitoes caught was significantly different among site types ($p = 0.00$). Thus, it was concluded that urbanicity does lead to a corresponding increase in mosquito disease vector species in and around the Birmingham, AL metropolitan area.

Agricultural Land Use Effects on the Shades Creek

Watershed

Emily Nelson Andy Gannon

Although agriculture is an extremely important industry, it has been well documented that water runoff from agricultural land can negatively affect the water quality and invertebrate diversity of surrounding stream ecosystems. The Shades Creek Watershed in Jefferson County Alabama contains 16% pastureland that produces non-point source pollutants that could increase turbidity, nitrites, phosphates, and fecal coliform bacteria in surrounding streams. These water quality factors could have a negative impact on the filter feeding abilities of invertebrates and affect their survival and diversity. ArcGIS was used to select study sites in Shades Creek or its tributaries that might be affected by agricultural and forested land runoff. Four agricultural test sites and four forested control sites were sampled multiple times over a five-month period. Invertebrate diversity was determined by the Shannon-Weaver and EPT taxa diversity indices and the pH, Nitrate, Phosphate, turbidity, dissolved oxygen and temperatures of the water were measured for water quality and analyzed. The fecal coliform units, nitrate, phosphate and turbidity levels were higher in the agriculture sites than in the forested sites. Forested sites also had more invertebrate diversity ($H' = 2.50$) than agricultural sites ($H' = 2.06$). Although this study is a brief measurement of an ongoing phenomenon, the results suggest a negative impact from agricultural land use.

Investigation of the Possible Role of Selected Pest Moth Species in Pollination

Andrew NeSmith and Wayne Shew

Insects play an important role in the pollination of plants. Lepidopterans contribute in significant ways to pollination networks and much is known of the role that butterflies play in these networks. Less is known about the role of moths in nocturnal pollination networks, but studies indicate moths may contribute significantly to pollination in some species. Numerous moths are known to be crop pests and negatively impact the plants they visit. We hypothesize that some of these pest moths may play a positive role as well as a negative one by serving as pollinators of select plants. We examined moths captured in corn and soybean fields in Blount County, Alabama, using “unitraps” baited with species-specific moth sex pheromones. Moths captured had their mouthparts and proboscides swabbed with cubes of glycerin jelly to remove attached pollen. These samples were then examined using light microscopy to count and identify pollen grains present. Two of the three species captured, *Mythimna unipuncta* and *Chrysodeixis includens*, had at least twenty percent of collected specimens carrying five or more pollen grains of one pollen type. These moths were considered to be regular flower visitors and probable pollinators. Twenty percent of *Ctenopplusia oxygramma* also carried five or more pollen grains, but too few moths were captured to confidently say that this species was a regular flower visitor. These three moths are known pest species, and these results support our hypothesis that some plant pests may play a positive role as pollinators in plant/insect interactions.

Characterization of Guanine Nucleotide Exchange Factor Specificity in *Schizosaccharomyces pombe*

Avery Newcomb and Melanie Styers

Secretory transport is vital to cellular function because cells need membrane proteins to exchange nutrients with the environment, as well as perform proper cellular signaling. Proteins are transported in vesicles that bud from the donor membrane when coat proteins are recruited by active ADP-ribosylation factors (ARFs). ARFs switch between the inactive GDP-bound form and the active GTP-bound form due to interactions with guanine nucleotide exchange factors (GEFs). In order to understand how GEFs contribute to the specificity of membrane traffic, our goal was to characterize the functions of two predicted fission yeast GEFs, *sec71* and *sec72*. In order to identify the specific ARFs activated by these GEFs, I treated wildtype (WT), *sec71Δ*, and *sec72Δ* yeast strains with brefeldin A (BFA). BFA is a drug that fits in the interface between the GEF and ARF and inhibits GDP exchange. Importantly, fission yeast only have two arf genes, *arf1* and *arf6*, and only *arf1p* activation is sensitive to BFA. We predicted that if *arf1p* is activated by *sec72p* and *arf6p* is activated by *sec71p*, then *sec72Δ* cells would be sensitive to BFA and *sec71Δ* cells would not be sensitive to BFA. Use of both a qualitative spot assay and a quantitative liquid growth assay revealed that the *sec72Δ* strain, but not the *sec71Δ* strain was sensitive to BFA. BFA sensitivity could be rescued by overexpression of *sec72p*, but not *sec71p*, suggesting that these proteins have distinct functions. These results provide evidence that these GEFs regulate distinct Arf activation pathways.

Regulation of Acetylcholine Concentration in the Neuromuscular Junction of *Rhinella marina* During Acetylcholinesterase and Butyrylcholinesterase Inhibition

Raleigh Payton and Andrew Gannon

Acetylcholinesterase (AChE) catalyzes the breakdown of the neurotransmitter acetylcholine (ACh) in the neuromuscular junction of skeletal muscle. Acetylcholinesterase inhibitors have been used in treatments of myasthenia gravis, a life-threatening disorder categorized by autoimmune destruction of acetylcholine receptors (AChR). These inhibitors have been found to show an increase in ACh levels and function in the neuromuscular junction. It has been hypothesized that ACh release is controlled by a rapid negative feedback mechanism. This hypothesis predicts that when AChE is inhibited, there will be an initial increase in force of muscle contraction and a decrease in the latent period followed by a gradual reversal in both measurements. Our data suggest that under cholinesterase inhibition, the force of skeletal muscle contraction decreases and latent period of muscle contraction increases after an extended period of time. We used cane toads, *Rhinella marina*, to measure the twitch force and latent period for skeletal muscle *in situ*. The data for muscle contractions within the first minute of inhibition showed no significant differences over time. Results between the control groups and the inhibitor group showed no significant difference. The force of contraction was found to significantly decrease between the first fifteen seconds and the final forty-five seconds ($n=9$, $p < 0.05$), but the latent period showed no significant difference between these two groups. These results suggest that negative feedback inhibition is so rapid that it has already taken effect within seconds of blocking AChE, and indicate that our understanding of ACh regulation in the neuromuscular junction is incomplete.

Cuboid variation among the Great Apes

Mollie Peavy and Jason Heaton

The cuboid bone is morphologically similar among many primates: *Pan* (chimpanzee), *Gorilla* (gorilla), and *Pongo* (orangutan). However, its position varies between each genus, depending on their major type of locomotion. The cuboid is involved in midfoot and hindfoot movements, such as walking in terrestrial primates and mobility in arboreal primates. For terrestrial groups, adaptations of the cuboid involve developing greater stability and support for body weight. Our goal is to determine significant differences in the cuboid between the three primates. It is hypothesized that there will be significant size and morphological differences between the cuboids of terrestrial and arboreal primates. Computed tomography (CT) scans from specimens curated at the Smithsonian's National Museum of Natural History were obtained and measured for analysis. Measurements of interest were the lateral length, overall breadth and depth, long and short metatarsal facets, long and short calcaneal facets, and medial plantar and dorsal lengths. All measurements were taken on 3D models using freeware (Meshlab). The medial dorsal length and the long metatarsal and calcaneal facets were observed to be substantially larger in male *Gorilla*, when compared to the other groups. Possible contributable factors to this difference in cuboid morphology include the larger body mass of *Gorilla* and its stronger adherence to terrestrial locomotion.

The Effects of Biofeedback Training on Respiratory Sinus Arrhythmia in College Students

Ashley Prouty and Andrew Gannon

Respiratory sinus arrhythmia (RSA) is the beat-to-beat fluctuation in heart rate that is in phase with the respiratory cycle. It is a result of interactions between the cardiovascular and respiratory systems such that heart rate increases during inspiration and decreases during expiration. RSA reflects the cyclical changes in vagus nerve input to the heart. The leading hypothesis for the cause of RSA is that pressure on the vagus nerve by the lungs during inhalation inhibits its depression of heart rate. RSA is commonly used as a way to index parasympathetic nervous system activity and has been conceptualized as an index of physiological and psychological flexibility. A high RSA has been associated with a more efficient regulation of stress and emotions, whereas a low RSA has been correlated with depression, anxiety, and inefficient stress reactivity. One way to increase RSA is through biofeedback training. This teaches people how to regulate and consciously control specific autonomic physiological processes by concentrating on physiological parameters, such as respiration and heart rate. It is unclear, however, if ventilation rate and tidal volume have an equal effect on RSA during biofeedback training. If these two parameters make equal contributions to RSA modification, then there will be no difference between the magnitude of RSA after biofeedback training using tidal volume and RSA after training using ventilation rate. The results from our study support this hypothesis, indicating that neither ventilation rate nor tidal volume is not more efficient at increasing RSA than the other.

**Analysis of behavior alterations and predation rates in
Uvulifer sp. parasitized *Gambusia affinis***

Bradley Pullen and Megan Gibbons

Black Spot Disease (BSD) is caused by a three-host digenetic trematode encysting into the skin and fins of the mosquito fish (*Gambusia affinis*) and other species of freshwater fish. The infection of intermediate hosts with a parasite has been shown to be accompanied with behaviors that increase the transmission rate to a terminal host. We hypothesized that if infection of BSD alters the behaviors exhibited by infected *G. affinis*, then BSD infected individuals will exhibit more conspicuous behaviors than non-infected individuals. We also hypothesized that if infection with BSD in *G. affinis* increases the chances that a predator will consume infected individuals, then *G. affinis* infected with BSD will have a higher instance of predation in the field than non-infected *G. affinis*. These results from the laboratory and field experiments will improve our understanding of how parasites impact behavior, and thus, the predation of their intermediate hosts.

Intra- and Interspecific Metatarsal Ray Variation among Humans and Extant Apes

Sujana Reddy and Jason Heaton

Studying the functional pedal morphology of *Homo sapiens*, *Gorilla gorilla*, *Pan troglodytes*, *Papio ursinus*, and *Pongo abelii* may expand our knowledge of the directional selection involved in shaping the hominoid foot. In turn, the results may reveal evidence for the shift to bipedalism – a hallmark of the human lineage. I hypothesize that if there is variation in the degree of torsion, dorsal canting, and robusticity between the rays of the metatarsals of extant apes and humans, then the pattern of torsion, dorsal canting, and robusticity observed in rays across species will vary interspecifically, but not as much intraspecifically. To determine if differences are present, computed tomography scans were utilized. To assess for differences, the length and width (for robusticity), the angular deviation from vertical plane (for dorsal canting), and the degree of torsion of the head in relation to the base of the metatarsals were measured. Results showed robusticity to be prominent in metatarsal one and five across all species of apes. *Pongo abelii* (orangutan) had the lowest average degree of dorsal canting, while *Papio ursinus* (baboon) and *Pan troglodytes* (chimp) had relatively higher degrees of dorsal canting across the metatarsals. Degree of torsion was on average higher across all species of extant apes. Data analysis indicates that there are structural differences in the metatarsals, which possibly relate to functional differences among the species. Future studies will provide a better understanding of the locomotor dynamics that exist between the metatarsals in extant apes.

Characterization of the Specificity of Arf Activation in *S. pombe*

Markia Robinson and Melanie L. Styers

The membrane trafficking system is essential to eukaryotic cells and requires proper targeting of transport vesicles that carry proteins and lipids between various organelles. The goal of this study was to characterize the specific relationships between ADP Ribosylation factors (Arfs) and Guanine nucleotide Exchange Factors (Gefs) that catalyze their activation. Together these proteins initiate the formation of vesicles. In order to determine the effects of loss of GEF activity on specific Arfs, we used confocal microscopy to explore the localization of fission yeast arf6p-YFP in strains lacking function of the sec71p and sec72p GEFs. Arf6 localization was then compared to the wildtype cells *sec71Δ* and *sec72Δ* strains in the presence and absence of the GEF inhibitor Brefeldin A (BFA). Our results revealed that arf6p localization was altered by combined loss of sec71p and BFA treatment, suggesting that sec71p and sec72p have redundant functions in recruitment of arf6 to the cell surface.

Analysis of Telomere Fragments in Breast Cancer Cell Exosomes

Anna Marie Ronderos and Kate Hayden

Recent studies from our collaborators have shown increased invasiveness of cancerous cells in the presences of exosomes and also in the presence of extracellular DNA, specifically synthetic telomeric DNA. In addition, studies from our lab have shown that cell-free telomeric DNA is found to be enriched in apoptotic DNA isolated from dying cancerous cells. This study aims to investigate whether or not telomere fragments are present in the exosomes excreted from various breast cancer cells lines, which may link the invasive inducing properties of exosomes to the presence of telomeric DNA. Exosomes were isolated from the supernatant of four different cell lines by the process of ultrafiltration. The unique telomere fragment sequence, 5'-(TTAGGG)_n-3', was isolated from exosomes through c-PNA magnetic bead extraction and PAGE analysis was used to characterize the isolated telomere fragments.

Analysis of Arf Activation in *Schizosaccharomyces pombe*

Tony Rossi and Melanie Styers

Membrane trafficking is vital for cell survival and proliferation. Regulation of vesicle formation is the cornerstone of membrane trafficking and relies on ADP-ribosylation factor (Arf) proteins to recruit the appropriate adapter proteins for proper cargo selection. Arf proteins are activated by another group of proteins known as guanine nucleotide exchange factors (GEFs). Because distinct Arf isoforms have been shown to be upregulated in breast and prostate cancer, understanding which GEFs activate which Arfs could lead to the identification of new therapeutic targets. This study used *Schizosaccharomyces pombe* as a model organism to attempt to determine whether different GEFs play distinct roles in Arf activation. The purpose of this study was to adapt biochemical methods previously employed using human cells to *S. pombe* to determine if the *sec71* GEF promotes Arf6p activation. Controls included GTP γ S or GDP treated lysates to establish upper and lower bounds of activated Arf proteins in yeast lysate. We used a pull-down assay with GGA3 binding domain coated sepharose beads to extract activated Arf proteins from *S. pombe* lysate. Western blot analysis was used to quantify the presence of activated Arf isoforms in the lysates. This study found that yeast Arf isoform concentrations in *S. pombe* are likely lower than concentrations of Arf isoforms found in human cells and may also have reduced affinity for GGA3 binding domains.

Relative Importance of Visual and Chemical Cues in Mate Choice of Healthy and Parasitized Females of the Western Mosquitofish *Gambusia affinis*

Arthur G. Shaw, Megan Gibbons

Sexual selection in animals drives competition for access to mates and preference for certain traits in members of the opposite sex. The techniques used during mate choice may involve aural, visual, or chemical cues which can serve as indicators for the health of potential mates. The western mosquitofish, *Gambusia affinis* has an interesting mating system, with the majority of mating events occurring through male forced copulation of females. Males tend to prefer larger females, which typically have higher fecundity. Black spot disease (BSD) is a common trematode parasite for *G. affinis*, and it occurs as visible black spots on the dermis of the body or fins. Prior research suggests that BSD may play a role in mate choice and social behavior of *G. affinis*. In this study we investigated time males spend in proximity of healthy and BSD-infected females under four conditions: 1. healthy females paired with chemical cues from healthy females (HH); 2. healthy females paired with chemical cues from BSD-infected females (HB); 3. BSD-infected females paired with chemical cues from healthy females (BH); 4. BSD infected females with chemical cues from BSD-infected females (BB). Males spent significantly more time near HH females than with HB or BB females, suggesting that chemical information regarding BSD is important for males when they are choosing social or mating partners. The results of this study demonstrate that the assessment of the health of conspecifics may require multiple sensory modalities.

Comparison of Habitat Preferences of the Invasive Northern Crayfish (*Orconectes virilis*) and the Endangered Watercress Darter (*Etheostoma nuchale*)

Hannah Spivey and Scot Duncan

Present in only five springs in Jefferson County, the watercress darter's (*Etheostoma nuchale*) limited distribution makes it extremely susceptible to threats. One possible threat is the invasive crayfish species (*Orconectes virilis*). Previous studies show that watercress darters occupy dense, sheltered habitats. Crayfish are also known to prefer sheltered environments. We hypothesize that *O. virilis* and *E. nuchale* prefer similar habitat features. If so, then *O. virilis* should be found more often in the habitats frequented by *E. nuchale*, than the habitats not frequented by *E. nuchale*. Previous work in the spring and fall has not seen a significant relationship between the habitat preferences of *O. virilis* and *E. nuchale*. I repeated these experiments in fall 2015 at Roebuck springs to obtain additional data for comparison. We analyzed crayfish capture frequencies for fall 2015 in the most common habitats of the spring run, and compared them to previously collected darter densities. We analyzed the fall 2015 data individually and then compared the fall 2015 season to fall 2013. Finally we analyzed all existing seasons combined. We did not find a significant difference in crayfish frequencies among habitats in fall 2015 or in the other seasons. We did not find a significant correlation between *O. virilis* frequencies and *E. nuchale* densities for fall 2015. This study contributed to our understanding of the relationship between the watercress darter and the invasive *O. virilis*. The more information we collect on the watercress darter, the closer we are to moving it off the endangered list.

Effects of Exogenous Acetylcholine in the Neuromuscular Junction of the Gastrocnemius Muscle in the Cane Toad, *Rhinella marina*

Peyton C. Thetford, Andrew T. Gannon

The neurotransmitter acetylcholine (ACh) is released from motor neurons and binds to acetylcholine receptors (AChRs) on the skeletal muscle membrane to initiate a muscle contraction. Cholinesterases (ChEs) remove ACh by breaking it down into its components to be recycled. Myasthenias gravis (MG) is an autoimmune disease that results in the breakdown of AChRs. MG causes muscle weakness and fatigue in skeletal muscles. This disease is currently treated by ChE inhibitors which block ChEs from breaking down ACh, increasing the amount of ACh to bind with AChRs. To determine the role of increased ACh levels we measured the force of contraction (FOC) and latent period (LP) in the gastrocnemius muscle of the cane toad, *Rhinella marina*, and increased ACh concentration via injection. We also inhibited the ChE enzymes (acetylcholinesterase and butyrylcholinesterase) to simulate the effects of the drug treatment used for MG. In both experimental groups the FOC decreased by roughly 30%. The LP increased by a minimum of 0.002 milliseconds and was significantly different than the control with p values < 0.05 in both the inhibited and uninhibited groups. It is known that increasing ACh concentration may not be the most effective treatment over long periods of time and these data support prior research. One possible explanation for the decreased FOC and increased LP might be the rapid response of the negative feedback loop limiting further ACh release.

Understanding the impact of sediment pollution on freshwater snail ecology

Katie Valin and Scot Duncan

While Alabama may be an international leader in freshwater aquatic biodiversity, its waterways are also suffering from one of the greatest modern extinction events in North America. Sediment pollution from urbanization is the primary contributor to this crisis. During rainfall events, silt, sand, and gravel from urban areas are washed into streams, smothering the cobbles and larger rocks in the stream bed. Because these new particles are younger and smaller than the preexisting larger rocks, we hypothesize that they sustain less algae, an important food source for stream organisms, and are more susceptible to displacement than larger rocks. If larger rocks are indeed more capable of accumulating algae as well as resisting environmental disturbances, then we predict that snail density will increase in response to increasing rock mass and/or surface area. In an urban watershed in Birmingham, AL, randomly selected rocks were measured for surface area, mass, and snail density. Preliminary results suggest that below a particle surface area of approximately 75.0 cm², snail density is virtually zero. However, as rocks increase in surface area beyond 75.0 cm², a positive relationship between snail density and rock size emerges. These findings suggest that large substrate may indeed represent a more suitable habitat for stream dwelling organisms than small substrate. Overall, the results from this study allow us to better understand the impact of sediment pollution on freshwater ecosystems and may assist in the future design of restoration efforts aimed at improving stream habitats.

Association Between Method of Delivery and Infant Characteristics in United States Births

Mariela Vega and Jason Heaton

Over the last few decades, the cesarean birth (C-section) rate has increased in the United States. The method of delivery either through vaginal or C-section has been associated with infant presentation (breech and cephalic), gestation and weight. In extreme birth weight categories and breech presentation, C-section delivery appears to reduce risk of infant deaths compared to those delivered through vaginal delivery. The purpose of this study is to examine the association between method of delivery and infant characteristics such as infant weight and gestation, but more specifically to examine the association with breech and cephalic presenting infants. We hypothesize that that if the C-section method of delivery reduces risk of infant death in extreme birth weight and breech presentation, then there will be a higher C-section rate in the low (499-1,499 g) and macrosomic (4,500-5000 g) weight breech-presenting infants. Using the Centers for Disease Control and Prevention (CDC) Vital Statistics database, birth data were compiled and analyzed. Broadly, results demonstrated that the C-section rate was higher for breech-presenting infants when compared to the cephalic-presenting infants. At shorter gestation periods, there was a wide range of variation for method of delivery. Comparatively, longer gestational periods exhibited a higher vaginal delivery rate. At low and high birth weights, the C-section rate was higher than it was for average weight infants. For the traits considered here, infant presentation was the greatest factor determining the method of delivery.

Does trematode infestation increase predation rates of western mosquitofish?

Kylie Wentworth and Megan Gibbons

Many species of trematode parasites have a complex life cycle, requiring two or more intermediate hosts and a terminal host. In some intermediate hosts, parasitic infestation of the brain may lead to altered behaviors, which increase the chance that the parasite(s) will be transmitted to the terminal host, thereby completing the parasitic lifecycle. However, some trematode parasites infect epidermal and dermal tissue rather than the brain, and less is known about whether or not these parasites influence intermediate host behavior. This field study has been designed to analyze if western mosquitofish with Black Spot Disease (BSD) caused by the dermal and epidermal infesting parasitic trematode *Uvulifer ambloplitis* have higher predation rates by birds (their terminal hosts) than fish without BSD, and if highly-infested fish are more likely to be consumed than lightly-infested fish. If birds display differential feeding patterns based on parasitic infestation levels, then behavior modification may play a role in the lifecycles of dermal and epidermal infesting trematodes.

Amino Acid Catabolism as the Primary Source of Sweat Ammonia

Scott Wheat and Andrew Gannon

Energy supplements for endurance athletes are designed to provide maximal energy for sustained exercise, and often contain both carbohydrates and amino acids, the building blocks of proteins. The body will metabolize amino acids after prolonged exertion has depleted stores of carbohydrates and fatty acids, or when the storage capacity for amino acids has been exceeded. The metabolism of amino acids creates a toxic byproduct, ammonia, and it is hypothesized that amino acid catabolism is a significant source of ammonia during prolonged exercise. In addition to urine, one pathway for ammonia excretion is in sweat, and during exercise it is thought that removal of ammonia via sweat is important as there is no increase in ammonia processing elsewhere in the body. Previous studies have found elevated sweat ammonia levels in athletes consuming a high protein diet over the course of a week. This study investigated if taking amino acid supplements before exercise caused increased sweat ammonia levels in endurance athletes.

The Effect of a Dynamic Warm-Up on Reducing the Rate and Severity of Injuries in the Birmingham-Southern College Women's Soccer Team.

Katie Williams, Peter Van Zandt, and Kyle Southall

Almost all athletes perform warm-up exercises before practices and games so that they can not only avoid injuries but also enhance their motor performance. Recent studies have begun to place an emphasis on sport-specific dynamic warm-up protocols as opposed to the traditional warm-up methods that rely heavily on static stretching. The purpose of this study is to determine if the implementation of a dynamic warm-up will decrease the rate and severity of lower extremity injuries for an NCAA Division III women's soccer team. This study takes a five-year epidemiology approach by using injury reports to compare the injury rates and severity for teams using either the traditional static-stretching routine or the sport-specific dynamic warm-up routine. The dynamic warm-up years saw the addition of a soccer-specific dynamic warm-up consisting of 20 exercises that were performed before every exposure, which includes any team practice or game in-season or during the preseason period. While there appeared to be a reduction in injury rates and severity in years where the dynamic warm-ups were used, the differences were not statistically significant.

Do Parasitized *Gambusia affinis* Respond Differently to Being Stranded? An Analysis of Behavior Modification.

Audrey Williamson and Megan Gibbons

Fully-aquatic mosquitofish, *Gambusia affinis*, routinely leap out of water to escape aquatic predators. However, this behavior may result in stranding, after which the fish may remain immobile for a period of up to 3 minutes before initiating movement of the axial body to reenter the water. Some trematode parasites with complex life-cycles impact the behavior of their intermediate hosts in ways that increase transmission to the terminal host. The digenetic trematode *Uvulifer sp.*, which causes Black-Spot Disease (BSD) in mosquitofish, has a three-host life cycle that includes freshwater snails and fish as intermediate hosts and birds as the terminal host. This study seeks to investigate a possible relationship between BSD infection and the mosquitofish's behavioral response to being stranded. A behavioral analysis on 40 parasitized and 40 unparasitized fish was performed to observe success of and amount of time until reentry into water after being stranded. If BSD-infected fish take more time to reenter water after being stranded, then they may have an increased susceptibility to predation by the terminal host of the trematode causing BSD. This would provide another line of evidence that parasites can alter the behavior of intermediate hosts in ways that accelerate the completion of their lifecycles. (Boumis et al. 2013 document *Gambusia affinis* may remain immobile for up to 3 minutes after being stranded before initiating movement attempts)

Effect of Temporal Bone Traits on Distinguishing Species and Diet in Primate Species

Patricia Woller and Jason Heaton

Recent fossil discoveries have added to the human evolutionary tree. An increasing number of these fossils are represented by skulls or portions thereof, as they are the most likely to be preserved in the fossil record. However, the fossil record is imperfect, and due to the paucity of remains, it is important to obtain as much taxonomic information as possible from those skeletal elements. In the fossil record, genetic data is often unavailable, especially for the earlier periods. As a result, morphological analyses of extant taxa are of extreme benefit. Due to its unique traits, the temporal bone may aid in distinguishing these early hominid species. And because of its association with the masticatory apparatus, the temporal should reveal clues about an organism's diet. Previously, some of these traits have been analyzed in hominid temporal bones, but have not been linked to diet. By determining the components of variation related to diet in extant taxa, future studies may be able to use this information to interpret dietary implications based on morphological differences among fossil taxa. We intend to determine if differences in these traits among the great apes and baboons can allow species to be distinguished from one another, and if these differences reflect dietary information.

Ypt4p Regulates Localization of Sec71p in Fission Yeast?

Savanna Woods and Melanie Styers

Periventricular heterotopia with microcephaly is a disorder that causes a significant decrease in neuronal migration that results in improper brain development and seizures. This disorder can be caused by mutations in the ARFGEF2 gene that codes for the protein BIG2. BIG2 drives vesicle formation in membrane trafficking. Rab4 was recently discovered to initiate a cascade of protein activation that promotes vesicle formation by recruiting BIG2 to the membrane. Our goal was to characterize the function of the protein ypt4 in fission yeast (the yeast homolog to Rab4) to understand more about protein recruitment during vesicle formation. To determine how ypt4p affects the localization of proteins, we analyzed localization of sec71p-YFP, the yeast homolog of BIG1. When analyzed the wild type cells had dispersed localization of the sec71 protein throughout the cell and along the outer membrane of the cell. The ypt4 Δ cells had localization of the sec71 protein that was concentrated at the tips of the cells. This data suggests that *ypt4* is needed for proper localization of sec71p to the membrane for the beginning stage of vesicle formation.