

## 2017 Belmont Undergraduate Research Symposium

### Biology I

Moderator: Jennifer T. Thomas, Ph.D.

April 20, 2017, 3:45-5:15 p.m.  
JAAC 2092

3:45 p.m. - 4:00 p.m.

#### **Feasibility of Paced Breathing to Alter Brown Adipose Tissue Activity**

Lindsey Whitehead

Faculty Advisor: Patrick Schneider, Ph.D.; Crystal Coolbaugh, Ph.D. & Theodore Towse, Ph.D.  
(Vanderbilt University)

Paced breathing improves insulin sensitivity and decreases blood pressure by modulating autonomic tone (sympathetic and parasympathetic activity) of various organs and tissues. Brown adipose, a recently discovered tissue linked to weight maintenance and metabolic health, is richly innervated by the sympathetic nervous system. However, it is unclear if brown adipose tissue activity is altered by paced breathing and if this contributes to improvements in metabolic health. The purpose of this study was to assess the feasibility of a paced breathing protocol to study brown adipose tissue physiology. The paced breathing protocol will include slow, normal, and fast paced breathing conditions performed on three separate days during cold exposure. Healthy adult subjects will be fitted with a three-lead electrocardiograph, respiratory belt around the diaphragm, and skin temperature probes on the finger, forearm, and clavicle. A perception based cooling protocol will be used to activate brown adipose tissue and elicit shivering. During the protocol, subjects will be wrapped in two water-circulating blankets, and water temperature will be decreased according to the subject's perception in ten minute blocks until continuous shivering occurs. Infrared thermography images, a noninvasive method to detect changes in skin temperature associated with brown adipose tissue activity, will be taken of the subject's torso before and after cooling. We will analyze differences in heart rate, heart rate variability, breathing rate, skin temperature, perception of cooling, and shivering temperature between breathing condition sessions. Collectively, these findings will elucidate if paced breathing can be used to alter brown adipose tissue activity.

4:00 p.m. – 4:15 p.m.

#### **The Effects of Fertilizer on Decomposition of Native and Invasive Exotic Plant Species in a Temperate Deciduous Forest**

Gary Noel

Faculty Advisor: Darlene Panvini, Ph.D.

Human activities introduce potentially harmful chemicals into the natural environment, but the introduction of natural elements, such as nitrogen, may be equally detrimental. This study examined the effects of nitrogenous fertilizer on decomposition of leaves from native and exotic plant species. The effects of canopy cover type were also considered. Leaves of native (*Acer*

*saccharum*) and exotic (*Lonicera maackii*) species were placed in leaf litterbags. Half of the bags included fertilizer, while the other half had only leaves. Bags were weighed and deposited onto the forest floor; one litterbag was removed every three weeks for six months and reweighed to determine mass lost. Both *L. maackii* and *A. saccharum* decomposed more rapidly in the presence of added nitrogen, with *L. maackii* showing statistically significant differences in decomposition. Additionally, *L. maackii* decomposed quicker than *A. saccharum* overall. These results suggest that the presence of additional nitrogen can exacerbate the role that exotic species have on decomposition and nutrient cycling.

4:15 p.m. – 4:30 p.m.

### **The Effect of Caffeine on the Chemotaxis Ability of *C. elegans* at Different Stages of Life**

Emily Shearon

Faculty Advisor: Robert Grammer, Ph.D.

There is a myriad of evidence to suggest that the vast majority of nervous system development is complete by the L1 life stage of *C. elegans*. However, no research exists that discusses the ability of worms at this stage to perform chemotaxis. This study aims to see how different concentrations of caffeine exposure affect L1 worms' ability to chemotax when compared to worms at the L4 stage of life. Caffeine is of significant interest in this study due to the large amount known about effects it can have on cognitive and motor skills in *C. elegans* and, more broadly, because it is a staple in various food products around the globe. Our data suggests that L4 worms treated with caffeine follow a similar trend to previous Belmont University research (Nunez & Grammer, 2015). Though it was expected that L1 worms would also follow this trend after caffeine treatment, the pattern observed was quite different. In the future, further replicates of the L1 experiments should be performed in order to determine if a 20 mM wash of caffeine really does significantly disable the worms' ability to chemotax more than other concentrations or if these results are due solely to L1 worms' inability to move as well their young adult counterparts.

4:30 p.m. - 4:45 p.m.

### **Behavioral Syndromes of *Elimia* Snails in a Predator-Prey System**

Ryan Tapley

Faculty Advisor: John Niedzwiecki, Ph.D.

Behavioral syndromes are a set of correlated behaviors in response to multiple situations with conflicting solutions, causing an animal to respond sub-optimally to a situation. Predators have big effects on prey behavior. Prey face trade-offs safety from predators and potential gains from increased foraging. We hypothesized a conflict, in snails, between actively forging under ideal conditions and restricting activity in presence of a predator. Snails were placed in cups a exposed to control water and water with crayfish kairomones. Snail movement was recorded in both types of water and compared to look for a syndrome. We were unable to detect a change in behavior due to predator cues. And while there was significant correlation between movements of a particular snails in both types of water, the low  $r^2$  value suggested only weak repeatability.

Without a significant predator effect we would be unable to detect a conflict or a behavioral syndrome.

4:45 p.m. – 5:00 p.m.

### **The Effect of Piracetam on *Danio rerio* with Ethanol-Induced Memory Impairment**

Mohamed Darwish

Faculty Advisor: Lori McGrew, Ph.D.

In this experiment, the neurotherapeutic effects of piracetam on memory were examined. Piracetam is a memory-enhancing nootropic drug that has been demonstrated to reverse induced memory impairment. Due to their similarities to humans, zebrafish are a popular model organism and were used in this study. Zebrafish were chronically exposed to ethanol and then treated with piracetam over a three-week duration to determine if memory impairment induced by the ethanol was alleviated by the piracetam. After the three-week duration, the fish were trained and tested using a T-maze with color cues and a reward and punishment system, and their choice latencies were analyzed. Results showed that untreated fish performed the best in the maze, while fish that were only exposed to ethanol performed the worst. Statistical analysis of the data showed no significance, but the data did show trends that could be researched further with additional experimentation.

5:00 p.m. - 5:15 p.m.

### **Examining the Effect of Convallatoxin, a Cardiac Glycoside, on the Growth of Colorectal Cancer Cells**

Sarah Anderson

Faculty Advisor: Chris Barton, Ph.D.

Colorectal cancer is one of the most commonly diagnosed types of cancer. Given these statistics, it is important that we continue to explore novel treatments that are effective at stopping the growth of these lesions. Cardiac glycosides are traditionally used for their ability to regulate the contractile function of cardiac cells. One of these molecules, convallatoxin, has been previously reported to induce cell cycle arrest in some cancer lines through its action on the Na<sup>+</sup>/K<sup>+</sup> ATPase pump. For example, previous research has shown that convallatoxin is effective at slowing the growth of both osteosarcoma and cervical cancer cell lines *in vitro*. In this study, we examine the effect of convallatoxin on the human colorectal cancer cell line, HCT116. Following treatment, we observed a decrease in cellular viability that is both time and dose-dependent in nature. In addition, we observed a significant decrease in mitotic cells, and a significant increase in apoptotic cells following exposure to convallatoxin ( $p < 0.05$ ). Lastly, we utilized an isogenic cell line lacking both alleles of p53 to analyze the necessity for this signaling pathway in response to convallatoxin exposure. In conclusion, our data suggest that convallatoxin is an effective compound, *in vitro*, to inhibit the proliferation of colorectal cancer cells. Our data also suggests that further research should be considered to evaluate the efficacy of convallatoxin to additional colorectal cancer cells, both *in vitro* and *in vivo*.