

Poster Presentation Schedule

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Oral Presentation Abstracts

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Agriculture

1 2:30pm Undergrad **Developing a Small Scale Aquaponics System for Chicago Homes**

*Ariana Oatman, Emmanuel Pratt [Chicago State University]

Aquaponics is a sustainable food production system that combines the technique of aquaculture with hydroponics in a closed-loop, recirculating water ecosystem. It highlights the critical connection between fresh water and food production by using up to 80-90% less water and space than traditional farming methods. Our goal is to determine the potential value of installing a small-scale system for a Chicago-area family. We have chosen Chicago's Chatham neighborhood as our candidate location. Chatham is economically diverse with employed, middle-income homeowners and other residents who are marginalized and have disproportionately lower access to resources that promote quality health outcomes. To demonstrate the viability of Aquaponics within a Chatham household, we built a 20-gallon AQUAPONICS system and collected data on costs of setup and maintenance, inputs and outputs, nutritional value, caloric value, average market price, and productivity of produce. Produce grown includes chard, basil, lettuce, and arugula. We also monitored power, water usage, and light levels. This allowed us to analyze the potential financial benefit of maintaining a system. A small-scale Aquaponics system, such as the 20 gallon AQUAPONICS system used in this exploration, can have a positive effect on a whole household in terms of economics, nutrition, and overall health outcomes. The exploration is intended to create a framework for analyzing the potential cost and health benefits in the context of a community adjacent to Chicago State University's Aquaponics facility.

Botany

- 2 4:00pm Undergrad White-rot Fungi as Biological Pretreatment Agents for Biomass-to-bioenergy Strategies**
 *Michael Bilek, Sunil Thapa, Erin Tuegel, Peter Liu, Thomas Canam [Eastern Illinois University]
 A major limitation to the use of lignocellulosic biomass for bioenergy applications, particularly ethanol production, is the recalcitrant nature of lignin. This polymer constitutes approximately one quarter of the dry weight of the cell wall material of plants, and is a major obstacle to accessing the sugar-rich cellulose and hemicellulose of biomass. Currently, biomass destined for cellulosic ethanol production is pretreated with harsh chemicals and/or high temperatures to separate lignin from the other cell wall components. These treatments are expensive and therefore negatively impact the overall economics of the process. A promising alternate to these traditional thermochemical techniques is biological pretreatment with white-rot fungi. These benign, naturally occurring fungi have the inherent ability to deconstruct lignin using a suite of modifying enzymes. They are easily cultured and require essentially no inputs after establishment on biomass. We investigated the efficacy of two strains of the white-rot fungus, *Trametes versicolor*, as biological pretreatment agents for *Miscanthus* (*Miscanthus x giganteus*), which is a fast-growing, perennial grass that is well-suited for many biomass-to-bioenergy processes. Our results indicate that *Trametes*-treated *Miscanthus* straw has more desirable bioenergy characteristics, such as improved lignin extractability, compared to non-treated material. In addition, the fungi were found to increase the energy content of the *Miscanthus* straw, and enhance the binding strength of pellets formed from the material.
- 3 2:30pm Undergrad Redesigning a Monitoring Network for the Southern Illinois University Edwardsville Nature Preserve**
 *Noah Dell, Francesca Stockton, Richard Essner, Peter Minchin [Southern Illinois University Edwardsville]
 In 1963, the campus of Southern Illinois University Edwardsville (SIUE) was established on 1077 ha of former farmland, which included some stands of mature oak-hickory forest. Reforestation since 1963 has led to a significant increase in forest area. In 2010, 14% of campus was dedicated as a nature preserve, including Sweet William Woods (SWW) in the southwest corner of campus and a corridor running north along the bluff line connecting SWW with Bohm Woods (BW) state nature preserve. A network of circular 0.075-ha vegetation monitoring plots was established in SWW and BW in 2006, initially as the basis of a southern flying squirrel habitat study, and has since been used to collect baseline data on vegetation, small mammals, birds, and insect communities. Analysis of historic aerial photographs in 2010 showed that some plots straddled the boundary between forest substands of different ages. In addition, the plot area is smaller than the 0.1 ha commonly used for sampling forest communities. We are redesigning the plot network to rectify these problems and extend it into the corridor region. Existing plots are being

enlarged to 0.1 ha and those that include forest of different ages are also being moved to locate them in forests of uniform age. On the redesigned plots, each tree with a diameter at breast height (DBH) of at least 2.5 cm is identified and its DBH measured. On relocated plots, data on shrub species density within 30 x 1 m belt transects and ground layer species cover in 0.5 x 0.5 m quadrats will also be collected. We will analyze the new data using ordination, clustering, and regression techniques to summarize patterns of variation in vegetation and examine relationships between community composition, diversity, and environmental factors. The redesigned monitoring network will be an essential tool for effective management of the SIUE nature preserve and will provide numerous opportunities for future research.

Cellular, Molecular, & Developmental Biology

- 4 4:00pm Grad** **An Examination in to the Effects of Neuropeptides on the Contractility of the Body Wall of *Lumbricus terrestris***
 *Kevin Jones, Kevin Krajniak [Southern Illinois University Edwardsville]
 FMRFamide is a native neuropeptide in annelids. Our lab has shown that FMRFamide causes a variety of changes to the contractility of digestive tract smooth muscle of the earthworm, *Lumbricus terrestris*. Since the digestive tract is connected to the body wall of the earthworm by septa we decided to exam the effects of FMRFamide and related peptides on the isolated body wall. A portion of the body wall from the clitellum to the pharynx was removed and suspended in a tissue bath. One end of the tissue was connected to a Grass Instruments force transducer and mechanical contractions were recorded on a computer using Iworx software. The tissue was challenged with increasing concentrations of peptide and the resulting changes in contraction rate and amplitude were used to construct log-concentration curves. FMRFamide caused a decrease in rate with a threshold of 10^{-6} M and an increase in amplitude with a threshold of 10^{-7} M. These results suggest that FMRFamide could be involved in regulating the motility of the body wall. We are currently investigating the effects of APKQYVRFamide, the only earthworm sequence that has been identified.
- 5 2:30pm Undergrad** **Cross-species Interactions between *Schizophyllum commune* and *Schizophyllum umbrinum* Pheromones and Receptors**
 *Katharine Martin, Emily Dimick, ¹Timothy Y. James, Thomas Fowler [Southern Illinois University Edwardsville; ¹University of Michigan]
Schizophyllum commune is known to have approximately 15,000 different mating types that involve an interaction between pheromones and G protein-coupled pheromone receptors. Contrary to *S. commune* having many mating types, *Schizophyllum umbrinum* may only have one mating type. Some of the proteins coded in the *S. commune* and *S. umbrinum* mating types are fairly conserved at the amino acid level. The predicted *S. commune* mature pheromones studied specifically in these experiments were Bbp2(4), whose amino acid sequence is DSPDGYFGGYC, and Bap2(3), whose amino acid sequence is EKPGGSLTYAWC. In assays, pheromone Bbp2(4) activates pheromone receptors Bbr1 and Bbr3, while pheromone Bap2(3) activates pheromone receptor Bar3. Bbp2(4) and Bap2(3) are comparable to predicted *S. umbrinum* pheromones SuPh2, whose sequence is DSPCGFFGGGYC; SuPh3, whose sequence is HKPGGYGGGYC; SuPh8, whose sequence is EKEGKTNAW AFC; and SuPh9, whose sequence is EKPGDSL TNAWC. Given the similarities in amino acid sequences between *S. commune* and *S. umbrinum* predicted mature pheromones, it was hypothesized that *S. umbrinum* pheromones would be capable of communicating with *S. commune* pheromone receptors. The hypothesis was tested by heterologous expression of these pheromones and receptors in the yeast *Saccharomyces cerevisiae*. Successful communication between *S. umbrinum* pheromone SuPh3 and *S. commune* pheromone receptor Bbr3 was demonstrated. Successful signaling

also occurred between *S. umbrinum* pheromone SuPh9 and *S. commune* pheromone receptor Bar3. However, SuPh2 and SuPh8 did not activate any of the *S. commune* pheromone receptors in the assays. At the level of pheromone response, *S. commune* and *S. umbrinum* appear to have not been completely isolated, at least at the molecular level. Other factors may keep these molecules from naturally interacting in a productive hybridization of the two species.

6 4:00pm Undergrad Morphological Changes in a Glioma Cell Line: A Scanning Electron Microscopy Study

*Nicholas Wagner, Linda Dybas, Janet Kirkley [Knox College]

The C6 glioma cell line is a well established model for the study of astrocytic differentiation. The C6 cell line was derived from rat glioma cells, and as such is often also used as a model for glioblastoma multiforme. Administration of the cyclic AMP (cAMP) analogue dibutyryl cAMP (dbcAMP) mimics an increase in intracellular cAMP, causing the C6 cells to differentiate into astrocytes. Astrocytic differentiation is characterized by morphologic changes and an alteration of protein expression and phosphorylation. In order to study this morphologic change, C6 glioma cells were cultured onto cover slips and exposed to dbcAMP over the course of seven days, and analyzed via scanning electron microscopy (SEM). Initially, compared to the untreated control, the cells became spindle shaped, typically with two or more long, thin processes, with a round cell body in between. Over the course of the treatment, the cell processes became thicker, and the cell bodies shrank. Additionally, the cells began extending their processes in a more organized fashion, with the processes of multiple cells running parallel to one another. SEM data will be correlated with findings from western blot analysis of signal transduction proteins.

7 2:30pm Undergrad DNA Microarray Analysis Reveals Putative Master Regulators of Liver Function

*Olivia Garrett, Gary Bulla [Eastern Illinois University]

Mechanisms driving tissue specific gene expression in mammals is complex. We have used cell culture models to identify master regulatory genes involved in establishing liver function. Recently, whole genome microarray analysis has been used to compare gene expression profiles between liver and non-liver cells. Initial studies identified over 300 genes that were fold repressed at least 5-fold in the non-liver cells. Several of these genes were identified as candidates for master regulators. However, it was discovered using this analysis that two well-known liver genes (HNF₁ and HNF₄) that help to establish liver function were not identified by this screen. In order to increase the ability of this technique to identify candidate genes, the 5-fold cut-off was lowered to 2.5-fold to identify additional candidate genes. Using this 2.5 fold repressed criterion, 427 additional repressed genes were identified. Subsequent bioinformatic analysis on this set of genes identified HNF₄ and HNF₁ as well as 14 additional candidate genes that may play role in establishing liver identify. This new list includes genes known to be involved in a number of genetic pathways, including processes such as apoptosis, signal transduction and cell

proliferation. Current studies include validation of microarray data and testing of candidate genes for liver gene rescue.

- 8 4:00pm Undergrad Determining mRNA Expression Patterns of the Endocytic Protein Intersectin (*itsn1*) in early *Xenopus laevis* Development**
 *Gretchen Walljasper, Cheng Cheng, Oscar A. Jimenez, Judith M. Thor [Knox College]
 Down syndrome (DS) is the most commonly occurring chromosomal abnormality. It is hypothesized that the pathology of DS results in part from a disruption in neuronal endocytosis. Studying genes involved in endocytosis and DS will help us understand how this disorder develops. One of these candidate genes is intersectin (*ITSN1*). *ITSN1* is present on human chromosome 21 and encodes at least two different isoforms produced by alternative splicing (*ITSN1-S* & *ITSN1-L*). Previous studies on intersectin have focused on adult function. Our study uses *Xenopus laevis* to characterize *itsn1* expression in early vertebrate development. *itsn1* is expressed throughout development and is elevated during gastrulation. We used in situ hybridization to visualize the localization of *itsn1* during development. We found that *itsn1* is localized to the neural derived tissues, indicating a role for Itsn1 in neural development. Current research includes using RT-PCR to amplify the unique untranslated regions (UTR) of *itsn1-S* and *itsn1-L* individually to determine how expression of *itsn1-S* and *itsn1-L* vary throughout development.
- 9 2:30pm Undergrad Deep Probing of Genome-wide Expression Profiles Reveals Dramatic Misregulation of Genetic Networks in Hepatoma Variant Cell Lines**
 *Kyle Hunter, Adele Dust, Gary A. Bulla [Eastern Illinois University]
 Understanding the mechanisms that either promote or suppress liver expression in terms of genomic expression is a crucial part of understanding liver development. We used whole genome microarrays to compare gene expression profiles of a liver tumor cell line (Fg14) with that of cell lines developed in our laboratory that have spontaneously lost the ability to express liver genes (hepatoma variant cell lines H11, M38, HS2, and M29). We previously reported a dramatic loss of liver-specific gene expression in these cell lines (reduced >5-fold), as well as activation (>5-fold) of a large set of genes, from which a set of candidate genes were identified that may play a role in driving liver phenotype. Here, we asked whether we might be missing candidate genes due to the lack of sensitivity of the microarray analysis. Using a 2.5-fold expression cutoff from the microarray data, we identified a large number of activated genes. Expression levels of a panel of genes with known functions in transcriptional regulatory pathways in this data set were validated with qPCR. Results show that micorarrays often underestimated the level of activation of gene expression. Several transcription factors identified in the data set were found to be strongly activated (5 to 32-fold) in the cell variant cell lines, suggesting that dramatic reprogramming has occurred in the hepatoma variant cells and that this process involves widespread misregulation of tissue-specific genetic networks.

10 4:00pm Grad

Does the Level of MitoNEET Determine the Outcome of Cancer and Diabetes Treatments?

*Sudip Paudel, Leonardo Altamirano, Amechi A. Alozie, Michael A. Menze [Eastern Illinois University]

8.3% of the total population, even more strikingly, 10.9 million or 26.9% of elderly people above the age of 65 years of the USA have diabetes. The American Diabetes Association states that diabetes caused 231,404 deaths as listed on the death certificates in 2013. MitoNEET is a small iron-sulfur cluster [2Fe-2S] containing protein that is localized to the mitochondrial membrane. Pioglitazone (Actos) binds to mitoNEET and increases peripheral insulin sensitivity, and inhibits the release of blood sugar (glucose) from the liver in type-2 diabetes. Enhanced iron content into the mitochondrial matrix, increased oxidative stress, and glucose intolerance, a preform of diabetes, are associated with mitoNEET knock-down. As the result of the enhanced mitochondrial iron content, increased respiration rates and a reduction in weight gain on a high fat diet were reported in mice. MitoNEET over expression increases tumor growth in nude mice. To investigate how pioglitazone mediated inhibition of iron-sulfur cluster transfer impacts on cellular respiration and cell proliferation through interaction with mitoNEET, we developed mitoNEET inducible HepG2-mitoNEET clones. We monitored the change in cellular thermal activity and cell proliferation rate to characterize the cellular respond to pioglitazone treatment. The heat flow (cellular activity) for HepG2 Tet-On cells under fully oxygenated condition is $-27.4 \pm 3.75 \mu\text{W}$ per million cells and that of pioglitazone treated cells is $-26.8 \pm 4.6 \mu\text{W}$. After transfection, the heat flow is significantly increased to $-51.22 \pm 0.94 \mu\text{W}$ and $44.58 \pm 1.12 \mu\text{W}$, respectively with and without the pioglitazone treatment. 30 μM and higher concentration of pioglitazone significantly reduced the cellular proliferation rate compared to controls. Pioglitazone disassembles complex I of the mitochondrial respiratory chain in vivo and in vitro. The decreases in the activity of complex I and complex III was reflected by a decreased cellular proliferation rate. Inhibition of the iron-sulfur cluster transfer thereby stimulating β -oxidation on pioglitazone treatment might be the cause of increased heat production in mitoNEET transfected cells.

11 2:30pm Undergrad

Is PITX1 a Repressor of Liver Function?

*Laura Dalla Costa, Gary Bulla [Eastern Illinois University]

The mammalian liver performs a large number of vital functions, many of which are negatively affected upon liver damage. While several liver-enriched transcription factors have been identified that promote liver function, it is unclear which genes are responsible for initiation and maintenance of the liver. We have used whole genome microarray analysis of cultured cells to identify genes that might play a role in dictating liver function. Results identified several candidate genes that are strongly repressed in hepatoma variant cell lines (derived from the parental hepatoma cells) compared to hepatoma cells. However, it was noted that while over 300 genes are repressed in the hepatoma variant cells, several genes were found to be activated. This supports the possibility that liver gene repression is partially an active gene-

driven process. One activated gene that was identified in the screen, PITX1, is a transcription factor known to be involved in organ development and left-right asymmetry. To test the impact of PITX1 on liver function, we transfected a PITX1-expressing vector into Fg-14 rat hepatoma cells. G418-resistant clones were picked individually, expanded and tested for PITX1 expression using quantitative PCR. GAPDH levels were used control for quality of RNA extracted. Two of seven clones overexpressed PITX1 by at least 5-fold. The extent of loss of liver function is now being explored by measuring expression levels of a panel of liver-specific genes. Preliminary evidence suggests that overexpression of PITX1 results in strong repression of several liver-specific genes and therefore suggests that PITX1 may serve to prevent liver differentiation.

12 4:00pm Grad

The Effects of FaRPs on the Contractile Activity of the Isolated Crop-Gizzard of the Earthworm *Lumbricus terrestris*

*Fred Cornwell, Kevin Krajniak [Southern Illinois University Edwardsville]

The contractile activity of the smooth muscle of *L. terrestris* can be regulated by a variety of neurotransmitters, including the family of FMRFamide-related peptides (FaRPs). Previously we used the recently identified earthworm FaRP, APKQYVRFamide, to explore the effects of FaRPs on the crop-gizzard of *L. terrestris*. The goal of this project is to determine the effects of other earthworm FaRPs on the contractile activity of the crop-gizzard of *L. terrestris* by exploring the importance of the valine substitution. The crop-gizzard was isolated and suspended inside of a tissue bath composed of worm saline. Contractions were recorded using a Grass force transducer, and the data was displayed utilizing Iworx Labscribe 2. Increasing concentrations of each peptide were applied and allowed to take effect. The changes in activity were used to create log-dose response curves. FVRFamide caused a decrease in amplitude with a threshold of 10^{-8} M followed by an increase in activity at higher concentrations. APKQYVRFamide caused a concentration dependent decrease in contraction amplitude with a threshold of 10^{-6} M, while FMRFamide caused the same response with a threshold of 10^{-8} M. These results suggest that FVRFamide might play a role in regulating the contractile activity of the earthworm crop-gizzard. They also indicate that the presence of phenylalanine in the fourth position from the C-terminus is more important than the valine substitution. Other FaRPs currently being tested are PAKHYVRFamide and FNRFamide.

13 2:30pm Grad

The Effects of the Oxytocin/vasopressin Family of Peptides on the Isolated Gizzard Ring of *Lumbricus terrestris*

*Christine Vu, Kevin Krajniak [Southern Illinois University Edwardsville]

Members of the oxytocin/vasopressin family of neuropeptides have been shown to modulate the activity of smooth muscles in invertebrates. Annetocin is an oxytocin homologue that was isolated from *Eisenia foetida* which regulates digestive tract motility. We recently showed that it modulated the isolated crop-gizzard of the earthworm, *Lumbricus terrestris*. Since this study examined the contractility of the longitudinal smooth muscle we decided to examine the effects of these peptides on the circular smooth muscle using

isolated gizzard rings. The ring was placed in a saline bath and mechanical recordings were recorded by a force transducer. The tissues were challenged with increasing concentrations of the peptide and the resulting changes in contraction rate and amplitude were used to create log-concentration response curves. Annetocin caused an increase in rate of contraction with a threshold of 10^{-8} M. The mammalian peptides arg-vasopressin and oxytocin were 100-fold less potent, suggesting that the *Lumbricus* receptor recognizes the earthworm sequence to a greater degree than the mammalian sequences. We are currently examining the effects of other peptides from this family on the gizzard ring.

14 4:00pm Grad

Neuromuscular Control of Mastication and Brux-like Movements in the Freely Behaving Rat

*Jaclyn Taylor, M. Mitchell Cunningham, J. Devin Wall, Paul E. Wanda, ¹Dan B. Welch [Southern Illinois University Edwardsville; ¹Southern Illinois University School of Dental Medicine]

Our research seeks to address the specific gaps in our knowledge of a potentially devastating movement disorder called bruxism. The multifactorial etiology of bruxism prevents full understanding of its control. The main hypothesis is that the rhythmic central pattern generating (CPG) circuits in the brain stem producing bruxism might be shared with those that produce normal masticatory movements; and that the normal suppression of those rhythmic movements can become deregulated during certain pathological conditions and/or by commonly prescribed medications. Our initial goal is to develop a freely behaving chronic animal model. Fine-wire electromyographic (EMG) recordings from the temporalis, masseter, and digastric muscles of freely behaving laboratory rats (*Rattus norvegicus*) were collected during mastication and bruxing/theogosis in order to characterize task-related motor patterns. Our preliminary data shows a significant difference in the cycle periods of each muscle between rhythmic bruxing and masticatory episodes ($p < 0.05$). We have extended our scope to include a detailed measurement of the level of coordination between two closing muscles and an opening and closing muscle during both natural behaviors. Phasic analysis and circular statistics show that the temporalis and masseter muscles are in-phase during mastication and bruxing/theogosis ($p < 0.001$). As expected, the digastric and masseter muscles are out-of-phase during mastication, however, in-phase during bruxing/theogosis ($p < 0.001$). Co-contraction of opposing muscles during bruxing/theogosis allows for new predictions to be made regarding neuromuscular control.

15 2:30pm Grad

Construction and Biological Analysis of a Folate PEG Fluorescein Magnetic Nanoparticle

*Snehal Chavda, Jeny Tan, Mekeda Carr, Walter Henne [Governors State University]

Membrane associated folate receptor (FR) is overexpressed on a wide variety of cancers including ovarian, endometrium, kidney, lung, breast, brain, and cells associated with inflammatory conditions such as activated macrophages. Thus,

this receptor serves as an attractive target to selectively deliver chemotherapeutic and imaging agents to FR⁺ cells using folic acid tethered conjugates. To this end, a folate fluorescein magnetic nanoparticle has been constructed using a folate fluorescein biotin bridge ligand in tandem with a commercially available streptavidin coated magnetic nanoparticle. Using fluorescence microscopy, the bridge ligand and nanoparticle were assessed via a bead assay and uptake in L1210 FR⁺ cancer cells, respectively. Importantly, uptake was blocked in the presence of excess folate indicating site specific action. Multimode imaging agents may ultimately be useful for diagnostic modalities involving MRI and optical based strategies.

16 4:00pm Grad

The Effects of Various FaRPs on the Isolated Pharynx of *Lumbricus terrestris*

*Tyler McKibben, Kevin Krajniak [Southern Illinois University Edwardsville]
Our laboratory has been examining the effects of FMRFamide-related peptides (FaRPs) on the digestive tract of the earthworm, *Lumbricus terrestris*. Many FaRP sequences have been isolated from annelids. Since FMRFamide has been shown to inhibit the contractions of the crop-gizzard, we decided to examine the effects of the peptide on the pharynx which is adjacent to these structures. The pharynx was removed from the animal, placed in a tissue bath filled with earthworm saline, and attached to a force transducer which was connected to a computer. We used Iworx software to record the contractions. Increasing concentrations of FMRFamide were injected into the tissue bath and the resulting changes in contraction rate and amplitude were used to create log-concentration response curves. The pharynx showed a complex pattern of spontaneous contractions with both large and small contractions. FMRFamide caused a concentration-dependent increase in large contraction amplitudes with a threshold of 10⁻⁸ M and rates with a threshold of 10⁻⁷ M. For smaller peaks FMRFamide caused a biphasic effect on the rate with an increase at 10⁻⁸ M and a decrease at 10⁻⁶ M, while it increased their amplitude with a threshold of 10⁻⁷ M. Recently our lab identified the first earthworm FaRP, APKQYVRFamide. Preliminary results showed that this peptide inhibited both types of contractions causing concentration-dependent decreases in both rates and amplitudes suggesting that the native peptide may be acting on a different receptor than FMRFamide. We are currently increasing the number of trials with this peptide to confirm these results.

17 2:30pm Grad

DNA Identity of *Schizophyllum umbrinum* B-mating type through PCR

*Emily Dimick, Karen Martin, Timothy James¹, Thomas Fowler [Southern Illinois University Edwardsville, ¹University of Michigan]
Schizophyllum umbrinum is a fungal species which has been described by Raper (1959) but has not been studied in depth. This species has the ability to produce viable basidiospores and appears to be homothallic as in having only one mating type and not having the ability to outcross. *S. commune*, a well-studied sister species, reproduces sexually using pheromones to communicate with compatible mates as a heterothallic. *S. commune* also produces basidiospores but has thousands of mating types, as part of a tetrapolar mating

system in which mating is determined by two unlinked complex genetic loci, one of which codes for both mating pheromones and receptors (*matB*). In this situation, the meiotic products of a mating would segregate 2:2 for the two variants of the pheromone/receptor locus. Many homothallic fungi are derived from heterothallic strains through mutations leading to self-activation of the mating pathway. *S. umbrinum* must also have a means to bypass outcrossing. Two ways we are exploring its reproductive behavior to look for evidence of self-activation of mating and to search for variation among progeny that suggests there maybe more than one mating type and outcrossing may occur. Using PCR, *S. umbrinum* pheromone genes *suph2*, *suph3*, *suph8*, and *suph9* and their flanking DNA have been targeted. To date, we have not detected any length differences in the PCR products among 11 siblings for any of the 4 genes covering 2.5kb of amplified DNA and spaced over 11kb in the genome, indicating potentially low DNA variation. This suggests that the mushroom that produced the 11 sibling strains was not produced by outcrossing but likely from a homothallic mating or a mitotic process that can produce viable basidiospores. There is evidence that many *S. umbrinum* cells are binucleate, but no evidence for the formation of dikaryotic cells with clamp connections (Raper, 1959). These features also point toward possible self-activation or mitotic division that led to sporulation.

18 4:00pm Grad

Nitrogen's Effect on the Growth of a Community of Acidophilic Organisms

*April Brown, Kai Hung [Eastern Illinois University]

At the Iron Mountain Superfund site in California, extremely acidic seeps with pH values as low as -3.6 and total dissolved metal concentrations as high as 200g/L have been discovered. Given these harsh conditions it was very astounding to discover that a consortium composed of a fungus and possibly a prokaryote was actually flourishing. The success of this consortium in these harsh environments brings up the question of what kind of macroelement, and how much, is needed, to support their growth. Previous results showed that altering the amounts of phosphate did not affect growth of the consortium, so I hypothesized that this consortium's growth might respond to the concentrations of nitrogen as a limiting factor. To determine the optimum level of nitrogen that this consortium needs, I experimented growth in a minimal medium containing 0.1% (w/v) glucose (pH of 2.0 with hydrochloric acid) supplemented with different concentrations of nitrogen (0, 25, 50, 75, and 100mM). Serial passage was conducted to minimize nutrient carry-over. Growth was quantified in 48-well plates visually. The results were compared to three controls: un-inoculated wells, glucose/yeast extract wells, and wells with H_2SO_4 . A follow up experiment tested the growth of this consortium in more specific nitrogen concentrations. The results of these experiments suggest that this consortium can grow in all concentrations of nitrogen. However, there seems to be no significant difference in growth at different levels of nitrogen.

Chemistry

- 19 2:30pm Undergrad Synthesis, Analysis, and Bio- Evaluation of a Novel Multifaceted Folate Conjugate**
 *Michael Sullivan, Walter A Henne [Governors State University]
 Advances in modern medicine and diagnostics are trending toward “guided missile” approaches which exploit various cell structures to deliver therapeutic and diagnostic agents to malignant cells while sparing healthy ones. Folate receptor (FR) is overexpressed on numerous cancer and immune system cell types, yet most normal cells in the body have little “high affinity folate receptor.” Based on this finding, folate based drug delivery, imaging systems, and diagnostic systems are in several stages pre-clinical and clinical development. This is a report of synthesis, analysis, and bio-evaluation of a novel multifaceted folate conjugate that can be used for rapid introduction of the imaging moiety, fluorescein, as well as a biotin moiety to exploit the ubiquitous use of streptavidin particles in both in vitro and in vivo diagnostic assays. Synthesis was undertaken using a solid phase approach that yielded a completed conjugate after cleavage from the resin. The conjugate was further purified, analyzed, and assessed by high performance liquid chromatography, fluorometry and mass spectrometry. Bio-evaluation of the conjugate was assessed on FR⁺ L1210 leukemia cells and ~3 μ M streptavidin coated magnetic beads. It was notably demonstrated that the crude conjugate could also be used without further purification if needed. Early studies show that this conjugate can prove useful in both in vitro and in vivo applications.
- 20 Grad Computational Studies on the Electronic Properties of Pharmacophores: A Density Functional Investigation**
 *Lisa Johnson, Ronald J. Terry [Western Illinois University]
 When considering drug design, the term pharmacophore generally refers to the functional groups (group of atoms in the molecule) that are responsible for the pharmacological activity of the drug. A term that is closely related to pharmacophore is bioisostere, which can be either an atom, functional group, or even a molecule which has physicochemical similarities that produce broadly similar biological effects. In this study we will concentrate on some of the common bioisosteric functional groups and their electronic structure. The electronic structure of a functional group gives information about the influence it is expected to have within a molecule such as acid-base property, partition coefficient, electrophilicity/nucleophilicity, solubility, charges, hydrophobicity, dipole moment, polarizability, ease of protonation, and so on. These electronic property densities are all in some way intimately connected to chemical reactivity. All molecular properties are determined by the potential function $U(r)$ and thus are obtainable through the electron density. Computations on various known pharmacophores will be carried out using Density Functional Theory (DFT) with the EDF2 functional and the medium-sized polarized basis set, 6-31G* so as to be consistent as possible. Calculated electronic properties will include atomic charges, HOMO and LUMO energies, total molecular energy, thermodynamic parameters, ionization energies,

electron affinities, chemical hardness, electronegativities, as well as proton affinities ($\text{EDF}_{2/6-311+\text{G}^{**}/3-21\text{G}}$). Calculated infrared spectra will be included, as well as surface and orbital plots for purposes of visualization.

- 21 2:30pm Undergrad Adsorption Isotherms of Basic Drugs on Reversed Phase Liquid Chromatography Using Ionic Liquids as Mobile Phase Additives**
 *Bryin Davis, Aaron Kerkemeyer, Kelsey Engle, Lauren Ward, Remington Leckonby, Tariq Ahmad, Tarab Ahmad [Western Illinois University]
 The determination of adsorption isotherms is an important step in the computer optimization of separations. It is useful also to predict the band profiles in liquid chromatography which reduces the cost, solvent consumption, and the time needed for the separations. The adsorption isotherms of basic drugs are determined on reversed phase liquid chromatography using an aqueous solution of an ionic liquid and acetonitrile. Adsorption isotherm data were collected using frontal analysis experiments. The adsorption data for Amitriptyline and Nortriptyline are modeled by an S-Shaped model. The adsorption data is compared to adsorption data without using ionic liquids. The models were validated by calculating the band profiles using the parameters of the isotherms. There was a good match between the experimental and the overloaded band profiles.
- 22 Undergrad Effect of 1-butyl -3-methyl Imidazolium Terafluoroborate Ionic Liquid on the Peak Asymmetry and Resolution of Basic Drugs on RPLC**
 *Aaron Kerkemeyer, Lauren Ward, Kelsey Engle, Bryin Davis, Tariq Ahmad, Tarab Ahmad [Western Illinois University]
 Room temperature ionic liquids (RTIL) are good solvents for both inorganic and organic materials, they are non-volatile, nonflammable, thermally stable, and recyclable solvents and they have some particular properties in chemical reactions. Currently they are being investigated widely as "green chemistry" solvents. Ionic liquids are used in reversed phase high performance liquid chromatography RP-HPLC as blockers for silanol activity and as mobile phase additives and as a replacement of organic modifiers. In HPLC the addition of ionic liquids has great effect on the separation of the compounds. They decrease the band tailing, reduce band broadening, and improve resolution. The objective of this work is to study the effect of 1-butyl 3-methyl imidazolium tetrafluoroborate BMIMBF_4 as a mobile phase additive on the retention behavior and separation of Nortriptyline and Amitriptyline on reversed phase liquid chromatography. Grace smart C18 column was used for this study. The mobile phases used for this study contain 0, 5, 10, and 20 mM BMIMBF_4 . The amount of acetonitrile used in the mobile phase is 0, 20, 30, and 40%. It was found from this study that both the asymmetry factor and the retention factor for Amitriptyline and Nortriptyline decrease by increasing the concentration of the ionic liquids or the percentage acetontirile in the mobile phase. The retention of the two compounds was reversed by adding the ionic liquid to the mobile phase. Decreasing the concentration of BMIMBF_4 to 10 or 5 mM or increasing it to 40 mM didn't increase the resolution, while using 20 mM of BMIM in the mobile phase has the best resolution for the two compounds.

- 23 2:30pm Undergrad Teaching the Applications of Supercritical Fluids in Analytical Chemistry**
*Tariq Ahmad, Bryin Davis, Kelsey Engle, Lauren Ward, Aaron Kerkemeyer, Tarab Ahmad [Western Illinois University]
A supercritical fluid is any substance at a temperature and pressure above its thermodynamic critical point (31 °C and 73 BAR for CO₂). It is not a gas, not a liquid, but has the advantages of both. It is another state of matter with the unique ability: fluids. SCF has the ability to diffuse through solids like a gas, to dissolve materials like a liquid, improving efficiency. Additionally, by changing the SCF density with minor changes in temperature or pressure, different compounds can selectively dissolve from a matrix ... do separations without changing solvents. CO₂ is most commonly used as a supercritical fluid. It is safe, inexpensive, environmentally friendly, and leaves no residue. These properties make it an ideal substitute for organic solvents. A Supercritical Fluid is fast and selective, allows for reduced extraction and purification steps, provides decreased processing time, has reduced organic solvents, and gives higher yield with lower cost. A strong foundation in Green Chemistry is key to our success as a society, and the use of Supercritical Fluids (SCF) is important to an education in green chemistry. By using Supercritical Fluids, our students will be leading tomorrow's green process with no petroleum solvents and no toxic residue. In this presentation, several applications of SCF will be shown including the use of SFC in extractions and its use in chromatographic separations. Some experiments can be used in the undergraduate Analytical Chemistry curriculum and they will be presented.
- 24 4:00pm Grad The Influence of 1,3 OMIM BF₄ Ionic Liquid as a Mobile Phase Additive on the Retention and Resolution of Nitroaromatics and Related Compounds**
*Bertlomiej Redlinski, Tariq Ahmad, Stephanie Sharp, Ashlie Heagy, Tarab Ahmad [Western Illinois University]
The identification of explosives and their degradation products is important in forensic and environmental applications. Complete separation of these structurally similar compounds using reversed-phase liquid chromatography has proven to be a challenge. The 8330 EPA method for the trace analysis of explosives includes isocratic HPLC separations of 14 components using C18 columns. These separations typically take over 30 min and are unable to separate all the compounds and a second column is usually needed leading to an increase in the analysis time and sample handling complexity. These disadvantages have led to the search for alternative LC for the separation of explosives. Room temperature ionic liquids RTILs are salts with melting points at or close to room temperature. They are good solvents, highly polar, environmentally benign, nonvolatile, nonflammable, and stable in air or water. RTILs can be used to adjust the selectivity, as well as to enhance the resolution by improving the peak shapes. In the present work we will investigate the effect of using OMIMBF₄ salts as mobile phase additives on the retention behavior, peak shapes, and resolution of the nitroaromatic and nitroaniline compounds using two C18 reversed phase columns; Prevail and Grace smart.

25 2:30pm Grad

Synthesis and Evaluation of a Folate-targeted, Acid-activated Dye

*Josh Carron, John Hakenjos, Walter A. Henne [Governors State University]

The folate receptor (FR) has emerged as an attractive target for both in vitro and in vivo imaging applications. Specifically, FR levels are elevated in numerous malignant tissues and diseases associated with inflammation (e.g. atherosclerosis, infection) and thus folic acid serves as a useful targeting moiety for the diagnosis and detection of these diseases. We describe the synthesis and assessment of a folate conjugate developed using the acid sensitive dye pHrodo™. The conjugate was readily taken up by FR⁺ L1210 leukemia cells as demonstrated via fluorescence microscopy. More importantly, uptake was blocked by excess folic acid and only observed during endocytosis. Given that the dye only fluoresces bright red in an acidic environment, this imaging agent should prove advantageous for assessing cells/tissues undergoing FR mediated endocytosis.

26 4:00pm Grad

Development of a New Method to the Synthesis of Biaryl Compounds by Detelluration

*Souseelya Vedula, Shaozhong Zhang, Jin Jin [Western Illinois University]

Biaryls, compounds containing two directly connected benzene rings, frequently featured in pharmaceuticals and agrochemicals, as well as forming the core of many functional materials (for example LEDs, liquid crystals, conducting polymers). In our research, a highly efficient new protocol for C-Te bond formation leading to symmetrical and unsymmetrical diaryl tellurides has been developed. The synthesis of symmetrical diaryl tellurides employed aryl iodides and elemental tellurium as starting materials in the presence of KOH. It is a one-pot reaction without using any catalyst. Utilizing this new protocol, a variety of aryl and heteroaryl iodides are reacted with elemental tellurium to afford the corresponding diaryl tellurides in good to excellent yields. These synthetic diaryl tellurides will be used as the starting materials to generate biaryl compounds under exceptionally mild conditions. The biaryls will be produced by the detelluration reaction on the diaryl tellurides using palladium (0) which is generated from commercially available and low cost palladium acetate and trimethylamine. The new method to generate biaryls will lead to a more benign alternative to the field of pharmaceuticals in the synthesis of biaryl containing molecules.

Computer Science

27 2:30pm Grad

Algorithmic Perspectives of Network Transitive Reduction Problems and Their Applications to Synthesis and Analysis of Biological Networks

*Satabdi Aditya, Bhaskar DasGupta, ¹Marek Karpinski [University of Illinois at Chicago; ¹University of Bonn, Germany]

In this survey we present numerous important theoretical findings on several transitive reduction problems on networks. These problems appear quite frequently in practice while dealing with analysis and synthesis of networks arising in cellular processes. Starting from a formal description of the equivalent digraph problem, a classical problem in combinatorial algorithms, we consider several non-trivial extensions or generalizations of this framework. Subsequently, we discuss the applications of these algorithms in system biology in the context of three major research domains -- synthesis and simplification of signal transduction networks, analysis of disease networks, and redundancy measurement of biological networks.

Earth Science

28 4:00pm Undergrad **Long-term Channel Recovery Upstream of a Spillway Failure: A Case Study of Lake Charleston, Illinois**

*Jacob Vesper, James D. Riley [Eastern Illinois University]

Lake Charleston is a water-supply reservoir that was created when the channel of the Embarras River was dammed in 1947. High rates of sedimentation within the reservoir led to the construction of an earthen dike in 1982 to divide the side channel reservoir from the diversion channel that directs water from the Embarras River to the spillway. After a moderate flood event in 1985, a portion of the spillway failed. A knickpoint, a type of channel scour, formed after the spillway failure and migrated thousands of feet upstream until it reached a rock ledge. Concern that the knickpoint would undermine the dike resulted in the construction of bendway weirs to steer flow in the diversion channel away from the dike. Cross-section surveys of channel bed morphology documented the extent of channel scour in the diversion channel soon after the spillway failure. The purpose of this field study is to repeat measurements at these cross sections to determine the spatiotemporal change of the bed morphology and the long-term recovery of the channel. Field data consist of bed depth measurements that were collected with hydroacoustic equipment and a differential GPS mounted to a boat. A general bathymetry map of the diversion channel above the spillway was also produced from the depth data. Results indicate a bed that does not show evidence of appreciable scour, suggesting sediment has filled in the scoured portion of the diversion channel.

Environmental Science

29 2:30pm Undergrad **Relationship of Management Intensity to Plant Species Diversity Indices in Ten Northeastern Illinois Prairie Reconstructions**

*Anthony Merisko, Mary Carrington [Governors State University]

Prairie reconstruction is a relatively new practice growing in popularity. This study, conducted in ten different prairie reconstruction sites in northeastern Illinois, addressed the hypothesis that more intensively managed reconstructions would have higher plant species diversities, higher numbers of native species, and lower numbers of non-native species. All of the study sites were prairies planted on former agricultural lands, ranging in age from < 20 years old to > 20 years old. A plant survey was conducted at each site during July or August 2013. Simpson's Diversity Index, Native Richness Index, and Alien Index values were calculated for each site from plant species and abundance data. These index values were correlated with hours/week/ha spent managing each site during the growing season. Hours/week/ha spent on management was positively correlated with plant species diversity ($r = 0.364$, $t_8 = 3.13$, $p\text{-value} = 0.007$), but was not correlated with native richness index ($r = 0.139$, $t_8 = 1.11$, $p\text{-value} = 0.149$). Unexpectedly, hours/week/ha spent on management also was positively correlated with alien index ($r = 0.476$, $t_8 = 4.33$, $p\text{-value} = 0.001$). This unexpected result could be interpreted as sites with the most alien species are receiving the most intensive management. A second hypothesis was developed relating plant species diversity to the abundance of *Solidago altissima*, an invasive native species, present at the sites. The hypothesis that *S. altissima* correlated negatively with plant species diversity was supported ($r = -0.780$, $t_8 = -4.92$, $p\text{-value} = 0.0005$), suggesting that *S. altissima* should be controlled to increase native plant species diversity in prairie reconstructions.

30 4:00pm Undergrad **Assessing the Invertebrate Composition of Reconstructed Prairies**

*Michael Belitz, Stuart Allison [Knox College]

This study was designed to assess the invertebrate composition of reconstructed prairies. Tallgrass prairie ecosystems are one of the most endangered ecosystems in the United States. In Illinois, less than 0.1 percent of the original tallgrass prairies remain. These prairies have been replaced by agricultural or urban land uses, and although the conversion of grasslands to new farmland has mostly ceased, remnant prairies continue to face threats from invasive weeds and expanding housing development. With this extensive loss of habitat, many animal species have been affected, including insects and other invertebrate species. Invertebrates have numerous functions in ecosystem processes, as they are decomposers, pollinators, herbivores, parasites, parasites hosts, seed dispersers, predators, and prey. Ultimately, by looking at the invertebrate composition of reconstructed prairies, this study attempted to find factors that may lead to reconstructing prairies with healthier invertebrate communities. Sweep netting and pitfall traps were used to collect invertebrates from seven reconstructed prairies of varying size and age in Knox County, Illinois. Invertebrates were also collected from one

remnant prairie in Knox County, Illinois. After collecting the invertebrates, they were identified to family. The remnant prairie had the highest family richness for both the invertebrates caught in pitfall traps and the invertebrates caught in sweep nets. For invertebrates caught with a sweep net, there was no relationship between the size of reconstructed prairie and the invertebrate family richness. However, there was a positive relationship between the size of the reconstructed prairie and the invertebrate family richness for invertebrates caught in pit falls. No relationship was found between above ground biomass and family richness of sweep net invertebrates. However, there was a negative relationship between above ground biomass and family richness for the pitfall invertebrate.

31 2:30pm Undergrad The Effects of Prairie Restoration Age on Bee Species Diversity

*Lauren Baldacci, Mary Carrington [Governors State University]

There has been a serious decline in hectares of prairies in Illinois. Decline of prairies results in a decline of native prairie plants and pollinators. The purpose of this study is to determine how prairie restoration age affects mean bee species diversity. A total of ten sites were used, five old sites (>20 years old) and five young sites (<20years). Bees were collected using pan-trapping methods and preserved in ethanol to be identified later using guides. *Bombus* sp. and *Apis mellifera* were counted by walking each transect. Two-tailed, two-sample t-tests assuming equal variance were used to analyze the data collected. Older sites were not found to be higher in mean bee diversity or richness. Older sites were found to be higher in evenness than younger sites. Young sites were found to be higher in mean bee diversity richness than older sites. Younger restorations had a richness that approached statistical significance ($t_8:2.31$; $p=0.059$). Lack of data may have been why the results were not statistically significant. Richness and evenness are components of diversity. Having older sites higher in evenness and younger sites higher in richness requires further analysis. It is possible that the bees were generalist and invasive species instead of native and specialist species.

32 4:00pm Undergrad Restoration and the Chronological Effect on Butterfly and Bee Communities

*Chad Kirian, Mary Carrington [Governors State University]

This study was done to determine if age of tallgrass prairie restoration has an effect on pollinator communities. The study tested the hypothesis that older restoration sites would have higher pollinator species diversities than younger sites as older sites should have more specialized pollinators in comparison to younger sites. For the study, ten restoration sites, five under 20 years old, and five older than 20 years were used. At each site bee and butterfly data were collected using bee traps and transect walking. The data collected showed that both younger and older sites are more abundant in generalized species than specialized ones, and that, unexpectedly, younger sites had higher bee species diversity than older sites. The high abundance of generalist species may be due to the high number of bumblebees and honey bees found at each site which was almost double that of any butterflies. Data collected only from

pollinators is not enough to infer why younger sites had higher diversity; further study with other factors might show if age of the restoration had an impact on diversity of species.

- 33 Grad Zooplankton Communities in Two Ponds Impacted by Storm-water Run-off**
 *Amanda Deardeuff, Jessica Loethen, Richard Brugam [Southern Illinois University Edwardsville]
 Storm-water run-off ponds are a common feature of urban environments. They often support a wide range of aquatic organisms including zooplankton. Zooplankton are microscopic animals that filter feed on one-celled plants and live in most aquatic ecosystems. Zooplankton also are eaten by small fish providing an important food chain link. The species composition of zooplankton communities can indicate the status of a pond because they respond to pollution and to fish predation. The goal of this study was to examine zooplankton communities and to determine whether storm sewer runoff affects the viability of the pond ecosystems. Zooplankton samples were collected from both the front and back ponds at the Watershed Nature Center, Edwardsville, IL using an 80 μ mesh plankton net. The zooplankton were preserved in formalin, identified, and counted under an inverted microscope. The data shows a large number of rotifer species which suggests that there is strong fish predation in both of the ponds. There is a strong seasonal succession of rotifer species suggesting strong variations in lake conditions with the seasons. Rotifers are generally the smallest zooplankton that are found in a pond. Fish are visual predators and eat what they can see. Fish usually eat the larger zooplankton, allowing the rotifers to escape. An IDNR fish survey was conducted at Watershed Nature Center in August of 2013, and found a diverse community of fish. The diversity of the fish and zooplankton communities suggests that the storm sewer runoff from the town has minimal impact on the ponds.
- 34 4:00pm Undergrad Phosphate Pollution in Two Urban Storm-water Run-off Ponds**
 *Jessica Loethen, Amanda Deardeuff, Richard Brugam [Southern Illinois University Edwardsville]
 Storm-water run-off ponds are a common feature of urban landscapes that are often reclaimed to become city parks. Because they are subject to run-off from city streets they often receive large amounts of plant nutrients making them extremely eutrophic with large algal and macrophyte blooms. A key nutrient in eutrophication is phosphorus. We analyzed phosphorus levels in 2 ponds (named Front and Back Lakes) at the Watershed Nature Center, Edwardsville, IL using the phospho-molybdate blue method. The goal of this study was to test whether runoff from the city of Edwardsville raises the total phosphorus levels in the lakes causing them to be eutrophic. Samples were collected from both the Front and the Back Lakes at biweekly intervals for a year. The samples were analyzed for different phosphorus fractions: total phosphorus (TP, the sum of all phosphorus fractions), ortho-phosphorus (PO_4^{3-}), particulate phosphorus (PP, phosphorus in phytoplankton) and dissolved organic phosphorus (DOP,

phosphorus in organic compounds) concentrations. We found that total phosphorus was high (averaging 317 µg/L Front Lake, 390 µg/L Back Lake) suggesting that the runoff from the city is causing eutrophication. About 50% of the phosphorus was ortho-P - a result that contrasts with most natural lakes where ortho-P levels are low. TP levels changed very rapidly between sampling dates possibly indicating contamination during storm events. Our results suggest that the ponds are extremely eutrophic. The OECD sets the TP level for a eutrophic condition at 50 µg/L. A potential cause of eutrophication in the watershed lakes is urban run-off.

35 2:30pm Undergrad Evaluating Native Plant Performance on a Midwestern Green Roof

*Alyssa Decker, ¹Kelly Luckett, ²Grace Koehler, Bill Retzlaff [Southern Illinois University Edwardsville; ¹Green Roof Blocks; ²Pizzo]

Green roofs have many ecological benefits that address many modern environmental issues. Many recent studies have evaluated Sedums on green roofs, on the other hand, there is much interest in seeing how successful native plants will perform on a green roof. In my study, planting treatments consisted of Green Roof Blocks planted with native species only, with native species plus Sedums, and with Sedums only. In the native only planting areas there are 8 plugs per block and one plug per species. The species in the native only planting areas were *Eragrostis spectabilis*, *Coreopsis lanceolata*, *Penstemon pallidus*, *Penstemon hirsutus*, *Koeleria cristata*, *Rudbeckia hirta*, *Aster laevis*, and *Carex muhlenbergia*. Natives were planted in between the current Sedum plantings in the natives plus Sedum planting areas. There are 6 native plugs per block and one plug per species in the native plus Sedum planting area. These species in the native plus Sedum planting areas were *Bouteloua gracilis*, *Buchloe dactyloides*, *Asclepius verticillata*, *Bouteloua curtipendula*, *Geum triflorum*, and *Sporobolous cryptandrus*. Native plants were planted in the two treatments on 5/29/2013 and 6/5/2013. All plants in the study plots were irrigated weekly as need through October, 2013. On November 7th and 8th 2013 plant survival was measured. In the plots with natives only, first growing season survival ranged from 16 to 64 percent. In the plots with natives plus Sedums, first growing season survival ranged from 1 to 100 percent. Survival of the four native grasses was greater than 99 percent in this first growing season.

Health Science

36 4:00pm

P2X₃ Receptors Co-localized with Markers for Neuroglia in the Human Tooth

*Dan Welch, Nisha Mehta, Adriana Marcuzzi [Southern Illinois University School of Dental Medicine]

There has been a recent focus in dental research involving purinergic signaling cascades. These cascades include molecular interactions involving purinergic receptors, termed P2 for extracellular ATP/ADP, and P1 for extracellular adenosine. P2X₃ receptors inside the tooth pulp might mediate dental pain. In addition, nucleotide/nucleoside metabolizing ectoenzymes and nucleotide/nucleoside transporters are present. These respective receptors, ectoenzymes, and transporters likely work together to initiate and sustain a salient response by nociceptive neurons. It is hypothesized that ATP may be released by mechanical distension or inflammation of odontoblasts. Neuroglial cells are known to provide a significant supportive function for neurons. Three distinct neuroglial cell populations adjacent to odontoblasts, glial fibrillary acidic protein (GFAP) serocytes, S100 telocytes, and HLA-II alocytes have been previously identified in peripheral human dental pulp. Initially, we examined the presence of the P2X₃ receptors on neurons co-localized with markers for neuroglia (S100) in the human tooth pulp (n=9). We attempted to co-localize these telocytes with glutamine synthetase (GS). GS has a significant role in metabolism of nitrogen, by catalyzing the condensation of glutamate and ammonia to form glutamine. We hypothesize that this may be essential for supporting neurons that release glutamate, as found in the central nervous system (CNS). We will systematically expand our investigation to the dorsal root ganglia, brainstem tissues, cranial sensory ganglia, and tooth pulp (rat and human).

37 2:30pm Undergrad Comparison of Theophylline and 8-Cyclopentyltheophylline on the Heart Rates of Neonatal Rats

*Stephanie Arnold, Kip McGilliard [Eastern Illinois University]

Neonatal apnea is a serious condition that affects the health of infants, especially those born prematurely. Methylxanthine drugs, such as theophylline (THEO) and caffeine, are administered to prevent or reverse this condition due to their respiratory stimulant effects. However, these drugs also cause stimulation of the central nervous system and the heart. Both side effects can be detrimental in preterm infants. Antagonism of adenosine receptors is the proposed mechanism of methylxanthine action. Xanthine analogs with increased affinity for adenosine A₁ receptors could produce respiratory stimulation while reducing cardiostimulant effects. For this study, THEO and 8-cyclopentyltheophylline (CPT), a potent adenosine A₁ receptor antagonist, were used. It was predicted that low doses of CPT necessary to stimulate respiration would produce less stimulation of the heart rate in comparison to higher doses of THEO that produce equivalent respiratory stimulant effects. Electrocardiograms (ECGs) were recorded in unanesthetized 4- to 7-day-old rats using mini-electrodes placed on the ventral skin surface. Randomly

assigned doses of THEO (10, 20, and 40 mg/kg), CPT (320, 640, 1280, and 2560 µg/kg), and saline (0.9%) were administered subcutaneously. THEO produced a dose-related increase in heart rate. The highest dose of THEO (40mg/kg) produced a significant 15% increase in heart rate above the pre-injection control. The highest of the dose of CPT (2560 µg /kg) produced a 12% increase in heart rate, which was not statistically significant. These data suggest that it might be possible to separate cardiac and respiratory stimulation of xanthine analogs based on selective antagonism of adenosine A₁ receptors.

38 4:00pm Grad

Tensile Bond Strength of Repaired Resin Modified Glass Ionomer

*Brooke Seesengood, ¹Christa D. Hopp, Paul E. Wanda, ¹Dan B. Welch [Southern Illinois University Edwardsville; ¹Southern Illinois University School of Dental Medicine]

In order to treat dental caries, the defective tooth structure must be removed and replaced by a restorative material. Resin modified glass ionomer (RMGI) is an important type of restorative material currently used. However, the optimal methods for repairing RMGI are poorly understood. The current study examined surface treatment options used to repair RMGI (GC Fuji II LC, GC America). 240 specimens were equally divided into four different water/temperature cycling environmental conditions. The conditions were 1) 5 minute delay, 2) 1 week delay with 1 thermocycle, 3) 500 thermocycles, and 4) 24-hour delay in a dry environment then 500 thermocycles. Each of the condition groups was equally divided again into three different surface treatment groups with 20 specimens in each. The treatment groups were A) sanding; B) sanding and acid etch; C) sanding, acid etch, and dental bonding agent. Our results suggest that RMGI is extremely susceptible to the simultaneous exposure of temperature cycling and water during the first 24 hours. Our main results are 1) during the first 5 minutes after the initial RMGI placement, the surface treatments made no difference to the tensile bond strength (NS), 2) when we weakened the RMGI by exposing it to water and temperature cycling immediately after initial placement, each of the treatments (A < B < C) had a significant incremental increase in bond strength (p < .05). Since RMGI is partially a composite resin, the surface treatment with dental bonding agent had a significant positive effect on the micromechanical bond strength of the repair.

39 2:30pm Undergrad

Development of Phase Analysis and Circular Statistics Techniques for Analyzing Masticatory Motor Patterns

*John Wall, ¹Dan Welch, Branden Bennett [Southern Illinois University Edwardsville; ¹Southern Illinois University School of Dental Medicine]

Circular statistics are used to assess data on an angular scale, and can be ubiquitous in science. Unfortunately, due to its circular nature such data cannot be analyzed with commonly used statistical techniques. An angular scale has no designated zero and, in contrast to a linear scale, the designations of high and low values are arbitrary. In order to address this issue, we have implemented a solution using Oriana 3.0 (Kovach Computing Services, Anglesey, Wales, UK), which provides the methods for the descriptive and

inferential statistical analysis of data on an angular scale. We cover the statistical background of the available methods and describe how to apply them to data. Finally, we analyze a dataset from rhythmic masticatory motor electromyograms, to demonstrate the utility of this technique. The angle and length of the mean vector were calculated using standard trigonometric functions. The angle of the mean vector (μ) represents the average phase value on a circular scale ranging between 0.0-1.0. The length of the mean vector (r) indicates the directional concentration of data points around the mean vector angle. We used the Rayleigh test to discriminate between uniform and unimodal-clustered phase distributions and the Watson-Williams test to determine if phase values were significantly different.

40 4:00pm

Mouse Immune Response can be Enhanced by the Antibiotic Daptomycin

*Dennis Kitz, Jessica Carrier, Nicholas Horn, Amber Wolfe, Erik Adkins [Southern Illinois University Edwardsville]

Daptomycin (aka Cubicin) Cubist Pharmaceuticals, Lexington, MA, is an FDA-approved drug of the cyclic lipopeptide class. This microbicidal antibiotic depolarizes the cytoplasmic membrane of gram-positive bacteria inhibiting their synthesis of DNA, RNA, and proteins resulting in cell death. Since previous work in our laboratory has shown that many antibacterial antibiotics can boost some aspects of mouse immune response, the effects of daptomycin were examined. These included determining that neutrophil cidal activity is not enhanced for yeast targets, while macrophage cidal activity for yeasts and T cell DTH activity to the contact sensitizing chemical DNFB(Sigma) are both significantly enhanced in mice. However it remains to be seen if such stimulation of immune response is also beneficial to patients receiving the drug. This work was funded in part by the Max Baer Heart Fund, Fraternal Order of Eagles.

41 2:30pm

Antibiotics Contributing to Enhanced Microbicidal Activity by Phagocytes and DTH Response by T Cells

*Dennis Kitz, Nicholas Horn, Jessica Carrier, Joshua Beasley, Shamsideen Ali [Southern Illinois University Edwardsville]

The study of antibacterial antibiotics has often focused on drug-pathogen interactions while drug-host interactions have not been thoroughly investigated unless prompted by toxic or allergic reactions. However a number of investigators have reported that antibiotics also can directly effect immune response. We have examined a group of five commonly prescribed antibacterial drugs including Ketek, Zyvox, Cubicin, Tigecycline, and Dalbavancin for their effects on peritoneal-derived macrophages cidal activity and on in vivo T cell DTH response to a contact sensitizing chemical DNFB(Sigma). Antibiotic mediated stimulation of two such important immune cell populations in the host raises the question of whether patients receiving these drugs have additional benefit from the therapy. This work was funded in part by the Max Baer Heart Fund, Fraternal Order of Eagles, and S.A. was an LS-AMP Research Scholar, NSF/HRD 094024.

Microbiology

- 42 4:00pm Undergrad Determining a Defined Medium for an Acidophilic Microbe**
 *Caitlin Greene, Yudong Qu, Kai F. Hung [Eastern Illinois University]
 “*Ferroplasma acidarmanus*,” strain fer1, an acidophilic archaeon, is a major contributor to the acidification at an abandoned iron mine where waters with pH as low as -3.6 were discovered. Runoff from this mine contributes to extreme pollution in and around the site, adversely affecting ecosystems as well as human health. A defined medium is necessary for examining the metabolic pathways of fer1 so better remediation plans can be devised. Growth was assayed first using the current medium, mfer, which contains yeast extract (YE, 0.1% (w/v)) with undefined vitamin components. Different concentrations of YE were assayed to determine the capacity of growth at different levels. Results showed that 5x YE inhibited growth whereas 2X YE had little effects. For defined amounts of vitamins, none of the assayed combinations and quantities have shown positive impact on growth. Carbon sources were examined by testing both organic acid mixtures as well as glucose at different concentrations. Organic acid mixtures showed inhibition of growth of fer1, whereas glucose had no effects on fer1 growth. Assays to test nitrogen utilization using a mixture of all 20 amino acids or with Casamino acid did not produce a sustainable media for growth. Growth testing was carried out in microaerophilic conditions and quantified using Optical Density at 590 nm or with Most Probable Number procedures. Growth assays were carried out in duplicate trials. Further testing of different carbon sources, in combination with vitamin mixtures will continue to help identify a defined medium for fer1.
- 43 2:30pm Undergrad Comparison of Genotypic and Phenotypic Characteristics of *Escherichia coli* Isolated from Untreated Surface Waters**
 *Ashley Dickey, Kyle Broge, Alexa Heumann, Karen Shaw, Yudong Qu, Christine Albers, Avery Allen, Lisa Ford, Ariana Maulding, Tamera Mettler, Anit Shah, Christina Tortorici, Kelly Toy, Steven Daniel, Kai Hung [Eastern Illinois University]
 Untreated surface water sources can pose public health concerns due to the dissemination of coliform organisms from these sites. The persistence of coliform organisms can also lead to increased chances of lateral gene transfer events. Monitoring the phenotypic and genotypic diversity of these sources can therefore shed light on the dynamics of population heterogeneity of coliforms. Water samples were collected from four different untreated surface water sources in Charleston, IL. Using Colisure and a MPN method with EC broth, forty-five *Escherichia coli* isolates were identified and tested for phenotypic diversity using both API 20E and Enterotube II identification systems. Results from these assays were then combined to generate a 12-digit bar code. In total, 21 unique bar codes were identified out of the 45 isolates. The susceptibility of these isolates to different antibiotics was assayed using the Kirby-Bauer method. One isolate showed evidence of multi-drug resistance to cefotaxime/clavulanic acid (30 mg/10 mg), ceftazidime (30 mg), and cefataxime (30 mg). Another isolate displayed intermediate levels of resistance

to cefataxime, while two additional strains showed intermediate resistance to cefaclor (30 mg) and cefuroxime (30 mg). The genetic diversity of all 45 isolates and *E. coli* O157:H7 (positive control) were examined using genomic DNA and multiplex PCR to detect the presence of 4 virulence genes (*stx1* and *stx2* [shiga toxin], *eaeA* [intimin], and *hlyA* [enterohemolysin]) and a housekeeping gene *uidA* (β -D-glucuronidase). Results indicated that two isolates possessed *eaeA* or *stx2* virulence genes. Results from this study will hopefully contribute to increasing our knowledge of the population dynamics and diversity of *E. coli* as well as contribute to our understanding of the effects of this microbe on public health and safety.

44 4:00pm Grad

Genetic Transformation of *Leuconostoc* By Treatment-Assisted Electroporation

*Joseph Lucas [Western Illinois University]

Leuconostoc spp. synthesize a variety of unique complex carbohydrate polymers called α -glucans. The α -glucans are characterized by a backbone of α -linked glucose molecules often containing branches at 1-3, 1-4, or 1-6. An example of an α -glucan made by *Leuconostoc* is called alternan, which has a backbone of alternating 1-6 and 1-3 linked glucose molecules. The unique linkage properties of alternan and other α -glucans grant the polymers physical properties that make them useful for certain applications. Development of an efficient gene-transfer system for *Leuconostoc* is important for understanding glucan synthesis and to enhance their biotechnology potential.

Electroporation is a widely used gene-transfer system for certain bacteria. Electroporation utilizes brief exposure to an electrical discharge to create transient pores within the cell membrane of bacterium. DNA or genes can then enter the bacterial cell through the transient pores. *Leuconostoc* has been resistant to gene-transfer systems such as electroporation probably due to its thick gram positive cell wall composed of peptidoglycan. The goal of this project is to improve the efficiency of electroporation methods in *Leuconostoc* by developing treatments that temporarily weaken the bacterial gram-positive cell wall to allow for efficient transfer of genetic material into the cell. Cell wall treatments may include cellular exposure to glycine, lysozyme, and penicillin. The *L. citreum* strain NRRL-1501, which lacks indigenous plasmids, was used as the host species for the tests to reduce gene transfer resistance due to plasmid incompatibilities. The effectiveness of each electroporation treatment was quantified by measuring *L. citreum* transformants per μ g of DNA transferred (transformation efficiency). Transformation efficiencies will be compared by ANOVA and TUKEY tests to determine which treatment, if any, is a statistical improvement compared to the control method (no cell wall treatment).

45 2:30pm Grad

Effects of Campus Bioswale and Non-Bioswale Treated Inputs on Retention Pond Entry Point and Runoff Zone Bacterial Abundance and Diversity

*Felicia Krelwitz, Timothy Gsell [Governors State University]

Retention ponds at Governors State University play an important role in collecting and treating storm water runoff before it enters the Thorn Creek

watershed. Many factors influence diversity and concentration of bacterial populations in these freshwater ecosystems including chemical, physical, and biological components from runoff. Retention ponds studied here include Beaver pond, which has bioswales leading from the parking lot with permeable pavers on the southern end of campus, and Café pond on the northern end, which does not have either. The main objective of this study was to compare the diversity and concentrations of various bacterial populations between ponds that utilize different treatment practices before being discharged into Thorn Creek. It is hypothesized the non-bioswale Café pond will have higher bacterial numbers and lower diversity in sediment and water, including fecal indicators. Water and sediment were collected every other month for a year. Aerobic bacteria, *Escherichia coli*, and fecal coliform abundances were assessed using 3M™ Petrifilms and colony morphologies were used to determine overall diversity. BiOLOG GenIII™ plates gave species IDs, and Ecoplates™ were used to determine the physiological fingerprints from each site. Results indicate aerobic counts for Café pond water generally were higher at inputs, lower at outputs. Beaver Pond averages were higher at outputs, especially in warmer months and when precipitation was higher. Aerobic averages of Café pond sediment were higher at input and lower at output while Beaver pond concentrations were generally higher at output and lower at input. Water and sediment concentrations at Beaver pond had similar trends while Café pond did not. Results indicate coliform and *E. coli* concentrations on Café Pond were higher at inputs than outputs. Sediment *E. coli* counts were higher in summer and fall. June rainfall and drier August conditions may have attributed to differences between water and sediment.

46 4:00pm Grad

***Helicobacter canadensis* Does Not Affect Monokine Secretion from Mouse Intestinal Explants**

*Sara Amirahmadi, Vance McCracken [Southern Illinois University Edwardsville]
Helicobacter is a genus of spiral Gram-negative bacteria colonizing the gastrointestinal tract of many mammalian and avian species. Multiple *Helicobacter* species cause gastric, intestinal, and hepatic diseases. *Helicobacter canadensis* is an emerging pathogen that has been isolated from several common wild birds as well as patients presenting with enteritis. Not much has been established about the epidemiology of *H. canadensis* and thus it is important to investigate its pathogenesis. In this study, *H. canadensis* treated mouse cecum and colon explants were evaluated for inflammatory cytokine release via ELISA. *H. canadensis* had no effect on secretion of pro-inflammatory cytokines IL-6, TNF- α , and IL-1 α .

47 2:30pm

Changing Patterns in Attachment as *Dreissena* Populations Mix

*Jerry Kavouras, Kaitlyn Curtis, Deirdre McCormick, Erin Cox, Taha Ghoulah,
¹James Maki [Lewis University; ¹Marquette University]
Dreissena polymorpha (zebra mussel) and *Dreissena bugensis* (quagga mussel) are aquatic invasive species that physically and chemically alter surfaces in North American fresh waters. The stage at which the *Dreissena* metamorphose from postveligers larvae to adult mussel is dependent on settlement, which is

influenced by environmental cues. The purpose of this study was to determine if biofilms directly influenced the attachment of mixed populations of *Dreissena postveligers*. The hypothesis is that surfaces covered with biofilms should have a statistically greater number of postveliger larvae than initially clean surfaces, if they facilitate attachment. A sampling device holding randomly arranged, mesh covered slides of virgin and used polycarbonate and baked glass were deployed into Milwaukee Harbor to develop biofilms for two weeks. The sampler was retrieved and the mesh was removed, allowing larvae to attach to prefilmed surfaces. Additional clean slides were added later and the sampler with both treatments of surfaces was redeployed for another two weeks. The sampler was removed from the slip and the number of postveligers on each slide was counted. Then the number of postveligers on each treatment was compared using analysis of variance (ANOVA). The data indicated that the number of postveliger larvae attached to prefilmed used polycarbonate was greater than the number of postveliger larvae attached to clean virgin polycarbonate (ANOVA, $P=0.027$). Based on these results, biofilms developed on prefilmed used polycarbonate may be composed of microbial species that provide cues to settling postveligers which facilitate attachment.

48 4:00pm

***Streptococcus mutans* Metabolizes Glutamine Differently in Ammonium-Free Media**

*Richard Finger, Matthew J. Ballard [Lindenwood University]

Streptococcus mutans, an oral pathogen, is known for fermenting sugars which creates the acidic environment for dental caries. Glutamine and other amino acids can be metabolized by *S. mutans* in different ways for either carbon or nitrogen needs. Glutamine, once transported into the cell, is deaminated twice to become 2-oxoglutarate for the citric acid cycle. The amino groups from glutamine are either used within the cell or released as ammonia, which will turn the media alkaline. The purpose of our experiments was to determine if glutamine metabolism changes when nitrogen sources are reduced and if this was influenced by carbohydrate concentration. *S. mutans* was grown in a defined minimal media (M9), which contains ammonium as a nitrogen source. Glucose and glutamine were added separately and together as energy sources. Experiments were repeated using modified M9 (no nitrogen source). Growth was measured in all experiments after 20hr by spectrophotometry; the pH of the media was measured after 20hr by pH meter. Our results confirm that glucose metabolism alone slightly acidified the media while glutamine metabolism alone produced slightly alkaline media. The main difference in metabolism of *S. mutans* was that at similar concentrations of glucose and glutamine, growth in M9 media produced an alkaline media while growth in Modified M9 created an acidic media. This result suggests that ammonia is released from the cell during glutamine metabolism when nitrogen is plentiful and used within the cell when nitrogen is limiting.

49 2:30pm Undergrad **The Microbiota Associated with Tear Staining in Small Dogs (*Canis lupus familiaris*)**

*Kaitlin Spaniol, Kaylin Sharp, Thomas Canam [Eastern Illinois University]

Tear staining is a discoloration of the periocular region, usually associated with canines weighing less than thirty pounds that have light-colored or white coats. This condition is not ordinarily a health concern, but pet owners tend to be offended by the sight of the stains, so they attempt to remove or prevent the staining. In an effort to better understand the microbial underpinnings putatively responsible for tear staining, swabbing was conducted of the periocular regions of small, white dogs from the local community (Coles County, IL) at a collaborating veterinary clinic. Swabs were streaked on either blood or Sabouraud's agar supplemented with chloramphenicol to encourage bacterial and fungal growth, respectively. Genomic DNA was then extracted from colonies of interest, followed by polymerase chain reaction (PCR) to amplify 16S and 18S sequences from bacterial and fungal preparations, respectively. After subcloning into plasmid DNA, sequencing of the ribosomal DNA was conducted, followed by sequence comparisons using NCBI's BLAST tool and sequence databases. The results provided a snapshot of the microbiota of dogs affected by tear staining. These procedures and microbiota profiles will be used in future studies examining the effects of diet (e.g. grain-free) on tear staining in dogs.

Science Education

50 4:00pm Undergrad **Hollyhock Plant Regeneration from Callus Differentiation as a Biology Teaching Tool**

*Chris Foster, Kelly Barry [Southern Illinois University Edwardsville]

Hollyhock (*Alcea rosea*), a summer perennial, is a self-sowing plant specimen that is commonly grown in gardens throughout the Midwestern portion of the United States. The micropropagation of hollyhock was carefully examined to determine the approximate time required for callus induction and plant regeneration. Hollyhock seeds were surface sterilized for five minutes with 1.0% sodium hypochlorite then rinsed three times with sterile distilled water. Sterile seeds germinated on agar-solidified ½ MS media under environmental conditions of 18 hours fluorescent light/6 hours dark at 23°C. Sterile hypocotyls were transferred to agar-solidified callus induction media under the same environmental conditions. Large amounts of green callus formed and shoots developed on the callus surface. Shoots were removed from the callus and transferred to agar-solidified ½ MS for root formation and establishment of whole plants. Several features of hollyhock propagation through callus induction make this a more suitable model than carrot for teaching concepts of structure and function, differentiation, and development. We present a lesson plan based on Next Generation Science Standards where students plan and conduct investigations with an ultimate goal of propagating hollyhock plants from callus. The lesson plan provides flexibility in that students may progress through the entire process from seed to callus to plant, or they may investigate components of the process.

Zoology

51 2:30pm

Fly High: Fire Ants Fly to Record Heights for Love

Gary Fritz, Yvonne Chapoloko, Ahmed Yusuf [Eastern Illinois University]

Although the Red Imported Fire Ant has been studied intensively for over 60 years, copulation behavior and associated dynamics of their mating flights have never been examined, much less observed. Ants captured during mating flights at varying elevations up to 450 feet elevation (using a tethered helium balloon with attached traps) were analyzed for the presence of sperm and also genotyped to determine their status with respect to two possible social forms that may be incipient species. The presence of sperm in females was inversely related to the presence of sperm in males at different elevations and these data suggest that copulation occurs primarily at elevations above 250 feet. Males at all elevations originated almost exclusively from single queen colonies, consistent with studies indicating males from multiple queen colonies play a relatively insignificant role in the insemination of all queens. We are unaware of any other animal that copulates at such high elevations.

52 4:00pm

Detection of Heavy Metals in Rocky Mountain Tailed Frog (*Ascaphus montanus*) Tadpoles Near Abandoned Mines in Northern Idaho

*Richard Essner, Jr., Hollie Lybarger, Z. Q. Lin, Richard Brugam [Southern Illinois University Edwardsville]

Amphibians are important bioindicators for environmental assessment. This highly diverse group of vertebrates is experiencing unprecedented declines worldwide due to a complex array of factors, including disease, habitat loss, invasive species, and environmental contamination. Heavy metals are especially problematic due to their persistence and ability to present a localized hazard even at non-lethal levels. Northern Idaho has had a long history of mining activity and many watersheds have experienced heavy metal contamination. These streams contain many sensitive species, including the Rocky Mountain Tailed Frog, *Ascaphus montanus*. While tailed frog populations are known to be especially vulnerable to logging and road building, the effects of local mining have not been documented. In order to assess the vulnerability of this species to heavy metal contamination, tadpoles were collected from three distinct populations across the Idaho Panhandle National Forest. Two sampling sites (Gold Creek and Beauty Creek) were characterized by abandoned mines in the headwaters of the streams, while a stream absent of any local historic mining (Bumblebee Creek) served as a reference site. Whole tadpoles were pooled and treated using EPA Method 3050B and analyzed for dissolved metal concentration ($\mu\text{g/g}$) using ICP-MS. We found high levels of lead and zinc contamination in tadpoles from mining sites as compared to those from reference sites. These results are consistent with other studies indicating that these stream communities are negatively influenced by abandoned mines.

53 2:30pm Grad

Plasma Growth Hormone and Body Morphometrics in Three Closely Related *Anolis* Lizard Species that Vary in Size and Habitat Use (*Sauria*, *Iguanidae*)

*Eric Mueller, David Jennings [Southern Illinois University Edwardsville]

Vertebrate body size is largely regulated by the actions of pituitary growth hormone (GH) and insulin-like growth factors (IGFs) and adult body size is positively correlated with circulating levels of both GH and IGF. A heterologous ELISA was used to determine circulating GH levels in three species of Anoles that vary in body size (*Anolis sagrei*, *A. carolinensis*, and *A. equestris*). Plasma dilutions used to validate the assay paralleled the standard curve. Plasma GH levels were lowest in *A. sagrei*, the smallest species. GH levels were higher in *A. carolinensis* and *A. equestris*, but did not differ between the two species despite significant differences in adult body size. Within each species, plasma GH levels were correlated with snout-vent length in *A. equestris*, but not in *A. sagrei* or *A. carolinensis*. In addition, several other morphometric measures were correlated with plasma GH only in *A. equestris*. Head width measures were negatively correlated with plasma GH, while both upper and lower hind-limb measures were positively correlated with GH. While our results suggest that changes in circulating GH levels underlie some differences in body size among Anoles, other components of the growth hormone axis (GH receptors, IGF levels, and IGF-binding proteins) are likely mediators of evolutionary changes in body size and shape in these lizards. Alterations to the endocrine control of growth are potentially tissue specific, and tissue differences in the actions of GH and IGF-1 may explain why some morphological features are correlated with GH levels while others are not.

54 4:00pm Undergrad

Analysis of Larval and Metamorphic Stages of Narrow-mouth Toad Jaw Muscle Development (*Gastrophryne carolinensis*, *Anura*, *Microhylidae*)

*Kristi Johnson, David Jennings [Southern Illinois University Edwardsville]

Microhylids are one of the largest families of Anurans (frogs), and have distinct characteristics that set them apart from most other frogs. They have small, pointy heads, round bodies, and narrow mouths. Not only are many of these characteristics present at adult stages, but they are also very distinct in the tadpoles as well. Microhylid tadpoles differ from most other tadpoles in that they are suspension feeders, and lack denticles, structures used for grazing in most tadpoles. This study examines jaw muscle growth and development in the mature tadpole and metamorphic stages of *Gastrophryne carolinensis* (Eastern Narrowmouth toad). The primary muscles examined the interhyoideus (IH), intermandibularis (IM), and the orbitohyoideus (OH). The IH and IM are the muscles responsible for the raising the floor of the mouth cavity, while the OH mainly deals with the opening of the jaw and lowering of the mouth cavity during feeding. To view individual muscle development at each stage, tadpoles were stained using immunohistochemistry with an anti-myosin antibody. This process allowed individual muscle fibers to be visualized under a dissecting microscope. For each stage, the length and width of each of the three muscles were quantified using image capture software. Early stages had little to no visible trace of the IM, while the later stages had a larger, more

robust IM. In all the stages examined, the IH and OH were clearly visible and grew with each stage. To further examine feeding musculature, the angle between the OH and other lateral jaw muscles was also quantified. In *G. carolinensis*, the angles between the OH and other muscles did not change over the stages examined. In contrast, similar analyses of tadpoles with more ancestral feeding showed more substantial remodeling of lateral jaw muscles during metamorphosis. These results suggest that metamorphic remodeling in narrowmouth toad jaw muscles is reduced compared to other frogs.

55 2:30pm Grad

Sequence Comparisons of Growth Regulatory Genes in Closely Related *Anolis* (Sauria, Iguanidae) Lizards of Differing Body Size

Seth Griffis, David Jennings [Southern Illinois University Edwardsville]

In vertebrates, body size is primarily regulated through the endocrine system's growth hormone (GH) axis. There are very few studies that examine changes that occur in this regulatory pathway and its relation to speciation. The current work compares the genes for insulin-like growth factor-1 (IGF-1) of several closely related *Anolis* lizards. Variations found between the IGF-1 genes of these lizards might help determine if the divergence in body size observed between species is related to changes in the IGF-1 component of the GH axis. Previous work has shown there are positive correlations between circulating GH levels and overall body size. Significant differences of GH levels were observed between the smallest species, *Anolis sagrei*, and two larger species (*A. carolinensis* and *A. equestris*). However, no difference was observed between *A. carolinensis* and the larger *A. equestris*. This suggests that other factors, such as IGF-1, play a role in regulating size in these lizards. IGF-1 genes have been sequenced in *A. sagrei* and *A. carolinensis*, but not in *A. equestris*. Changes in the IGF-1 genes of these species could explain the differences in sizes between species with similar plasma GH levels. Sequence differences might affect the receptor binding ability of the IGF-1 protein and/or its ability to interact with insulin-like growth factor binding proteins (IGFBPs). Interactions with IGFBPs may be important in regulating IGF-1 levels by extending the half-life of IGF-1 in the circulation. Prolonged half-lives could result in reserves of IGF-1 circulating in the blood. Differences between species in IGFBP interactions may also be responsible for the sizes variations. The initial sequencing of two of the main IGFBP genes involved in regulating plasma IGF-1 levels is currently underway.

56 4:00pm Undergrad

The Impact of Windows and a Wind Turbine on Bird and Bat Mortality at Heartland Community College in Normal, IL

Allyson Edwards, Tyler Kassing, David Horn, Gregg Marcello [Millikin University]

Windows and wind turbines are two large sources of human-caused bird and bat mortality. We examined mortality at a large turbine and windows on buildings at Heartland Community College in Normal, IL. To examine bird and bat mortality at the wind turbine, we searched for carcasses four times weekly from August 10 - September 18, 2013 in an area 120 m x 120 m centered around the turbine base. From October 19 to November 13, 2013, we conducted searches for bird carcasses around seven academic buildings. We

found zero bird or bat carcasses around the turbine, and five bird carcasses around buildings. Similar to other studies on avian mortality, we found in the first year of our study that glass windows are a greater source of bird mortality compared to a wind turbine. Much emphasis is being placed on the construction, siting, and use of wind turbines, however, similar effort has not been achieved with windows which are more likely to be the greater overall threat to birds.

57 2:30pm Undergrad Spatial and Temporal Patterns of Abundance and Diversity of Coleoptera and Orthoptera in Leaf Litter Communities of Mature and Regrowth Oak-hickory Forest In Southern Illinois

*Heather Bible, Melisa Hillman, Jason Williams, Peter Minchin [Southern Illinois University Edwardsville]

Insects often play a role as bioindicators in the fields of restoration and conservation, giving information about macro- and microhabitat variation. In 2010 about 14% of the campus of Southern Illinois University Edwardsville (SIUE) was dedicated as a nature preserve. Our research contributes baseline data on leaf litter insect communities in oak-hickory forest areas of the preserve. We sampled in both mature forest and regrowth forest about 35 yr in age. Our hypothesis is that leaf litter insect communities differ with forest age. We utilized existing permanent vegetation monitoring plots, three in mature forest and three in regrowth forest that was established in the 1970s, and collected samples from May 2013 through October 2013. Every two weeks, we established four pitfall traps on each plot, located along transects radiating at random bearings from the center. Traps consisted of plastic drink cups inserted into holes made with a bulb planter, with the rim of the cup level with the soil surface. Leaf litter disturbed in establishing the trap was carefully repositioned. About 3 cm of ethylene glycol was placed in each cup. After one week, samples were collected and stored in glass jars labeled by plot and date. In the lab, we separated invertebrates from leaves and debris and sorted them by order. We are currently keying Coleoptera and Orthoptera to family or genus. Preliminary data suggest a difference in composition and diversity of Coleoptera and Orthoptera between the mature and regrowth forest. When processing of samples is complete, we expect to definitively test our hypothesis and also characterize both the variation in communities between forest types and temporal changes in abundance of taxa.

58 4:00pm Undergrad Exploring the Overwintering Strategies of a Cold Water Anuran, *Ascaphus montanus*

*Lawrence Werner, Richard Essner, Jason Williams, ¹Travis Wilcoxon [Southern Illinois University Edwardsville; ¹Millikin University]

Most overwintering amphibians do not survive extracellular ice formation (i.e. freezing) and none, to our knowledge, use supercooling (remaining liquid below the melting point of their body fluids) as a strategy to survive low temperature. The cryophilic anuran, *Ascaphus montanus* is native to the northwest of the United States. These frogs overwinter in small, fast moving streams and likely encounter frass ice (which would promote internal ice

formation) and/or liquid water at temperatures below 0°C. Thus, *A. montanus* may regularly use the strategies of supercooling and/or freeze tolerance to survive the winter. Currently we are cold-hardening adult *A. montanus* by cooling them from 10°C to 2°C over a two month period. In mid-March we will assess their potential overwintering strategies by cooling the frogs from 2°C at 0.2°C per h to determine their supercooling point. In addition, we will assess their ability to remain supercooled by cooling them to -1°C and record how long they remain liquid. Lastly we will assess their ability to resist inoculative freezing and survive freezing by cooling a third group of frogs to -1°C before applying an ice chip to the skin of the frogs and recording the time until freezing. In addition, we will hold the same group of frogs frozen for one week prior to warming and determining survival.

59 2:30pm Grad

The Effect of Climate Change on Overwintering Metabolic Rate of the Goldenrod Gall Fly, *Eurosta solidaginis*

*Brooke Smith, Jason Williams [Southern Illinois University Edwardsville]

Overwintering insects must maintain a suppressed metabolism to preserve a finite amount of metabolic reserves needed for survival and spring development. Even though suppressed, overwintering metabolism is correlated with temperature. Thus, elevated temperature over the course of a winter, such as what is projected to occur due to climate change, may have profound effect on an insect's metabolism and levels of spring energy reserves. To determine the effect of elevated winter temperature on metabolism we are measuring oxygen consumption from larvae of the goldenrod gall fly, *Eurosta solidaginis*, held at average winter temperatures (-3.4 °C), or at projected increased temperatures (-0.4 or 1.6 °C) from December of 2013 until spring of 2014. As expected, metabolic rates were over two-fold higher in larvae held at 1.6 °C compared to those subjected to -3.4 °C ($3.8 \pm 0.6 \mu\text{l O}_2 \cdot \text{h}^{-1} \cdot \mu\text{g}^{-1}$). Interestingly, those subjected to the elevated winter temperature, in particular the -0.4 °C treatment reduced their metabolic rate by greater than 30% over the course of winter, from $6.1 \pm 1.1 \mu\text{l O}_2 \cdot \text{h}^{-1} \cdot \mu\text{g}^{-1}$ on Dec 15 to $4.1 \pm 0.7 \mu\text{l O}_2 \cdot \text{h}^{-1} \cdot \mu\text{g}^{-1}$ on Feb 20. Thus, goldenrod gall fly larvae may be able to adjust their metabolism to minimize metabolic resource loss at elevated temperatures. In this ongoing study we will determine the effect of the above simulated overwintering temperatures on spring survival and use of metabolic reserves, primarily lipid and carbohydrate.

60 4:00pm Grad

The Effect of Repeated Bouts of Anoxia on Oxidative Stress, Cold Tolerance, and Survival in the Freeze-tolerant Goldenrod Gall Fly (*Eurosta solidagini*)

*Kelsey Reger, Jason Williams [Southern Illinois University Edwardsville]

A small set of overwintering insects are termed freeze tolerant and can survive the anoxic and osmotic stresses associated with extracellular ice formation. A recent study indicated repeated freezing negatively impacts survival greater than a single freeze of the same cumulative duration. However, it is unclear if the reduced survival is due to repeated cellular osmotic stress and/or oxidative stress during oxygen reperfusion upon thawing. To determine if repeated

anoxia and oxygen reperfusion may reduce survival, we measured levels of oxidative protein damage, rates of pupation, and cold tolerance of *Eurosta solidaginis* larvae subjected to either 0, 10, 20, or 30 cycles of diurnal anoxia/reperfusion. To standardize for time spent anoxic, we also tested a separate group of larvae that were exposed to a single bout of anoxia for 15 straight days. Repeated exposure to anoxia induced oxidative damage to proteins as larvae subjected to 30 diurnal cycles had a 32-fold increase in advanced oxidation protein products compared to the other treatments (0.087 ± 0.17 mmol chloramine-T $\cdot\mu\text{g protein}^{-1}$). Even though repeated anoxia subjected animals to oxidative stress, it had little effect on animal survival, as pupation percentages averaged 75.2% for all groups. Interestingly, repeated anoxia limited cold tolerance as animals subjected to repeated anoxia followed by an exposure to -80°C for five days had reduced fat body cell survival ($61.3 \pm 2.5\%$) compared to controls ($69.3 \pm 2.9\%$). In conclusion, repeated anoxia and oxygen reperfusion resulted in oxidative stress, especially with increased bouts of exposure, however it did not negatively affect organismal survival. Anoxia exposure did reduce cold tolerance and may work synergistically with other stressors associated with freezing to limit survival to repeated freezing and thawing in nature.

61 2:30pm Undergrad The Effect of Cholesterol Supplementation on Chilling Injury, Rapid Cold Hardening, and Performance After a Low Temperature Exposure

*Zibin Zhang, Jason Williams [Southern Illinois University Edwardsville]

Chilling injury is often lethal and occurs when cell membranes transition from a liquid crystalline to gel phase at low temperature. Certain insects undergo rapid cold hardening (RCH), which alters phospholipid fatty acid tails and allows them to resist cold-induced phase transition. For example, RCH will allow adult fruit flies raised at room temperature to survive a 2h exposure at -7°C if first subjected to 10°C for 30 min. Other membrane constituents (such as cholesterol) can also prevent membrane phase transitions, yet their effect on minimizing chilling injury or enhancing RCH are largely unknown. To examine this, we determined survival to low temperature, ability to RCH, and markers of low temperature tolerance (chill coma recovery time and post-cold walking performance) in *Drosophila melanogaster* fed either normal (cholesterol absent) or cholesterol enhanced food. Flies augmented with exogenous cholesterol survived a direct transfer to -6°C at a higher rate than those fed a normal diet (68 ± 6.9 to $22 \pm 14\%$). In addition, exogenous cholesterol enhanced a fly's ability to undergo RCH as $98 \pm 0.7\%$ of those subjected to 10°C for 2 h prior to a 1 h exposure to -6°C survived compared to only $80 \pm 5.0\%$ for those fed cholesterol-free food. Augmenting food with cholesterol also reduced chill coma recovery time from 150.4 ± 9.3 to 17.1 ± 0.4 min in RCH animals exposed to 0°C for 5 h. Lastly, cholesterol augmentation increased walking performance as $90.9 \pm 0.9\%$ successfully passed a vertical walking test 48h after a low temperature exposure compared to only 64.7% of those fed a normal diet. In summary, cholesterol which functions to order plasma membranes, greatly enhances survival to and ability to undergo RCH in *D. melanogaster*.

62 4:00pm Grad

Population Genetics of the Black Spotted Topminnow using Genomic SNP Analyses

*Eric Westhafer, ¹Jacob Schaefer, David Duvernell [Southern Illinois University Edwardsville, ¹University of Southern Mississippi]

The black spotted topminnow, *Fundulus olivaceus*, exhibits a broad distribution ranging from southeastern Texas to central Missouri. Within drainages, this species occupies the full range of habitats along the river continuum from intermittent headwater streams to the margins of large rivers. This distribution makes *F. olivaceus* an excellent model for studying population dynamics across heterogeneous habitats and environmental gradients. We sampled headwater and large river environments in the Gasconade and Meramec Rivers in Missouri to assess the impacts of migration, genetic drift, and possibly natural selection at the local population level. Genetic analysis was conducted by sampling single nucleotide polymorphisms (SNPs) using the genotype by sequencing (GBS) method. The data set included 248 individuals sampled from two headwater and two large river habitats in each drainage. A total of 5744 loci with less than 3% missing data were analyzed. An analysis of molecular variance (AMOVA) of the complete data set revealed that 20% of the variation was distributed between drainages, 9% of the variation was distributed among populations within drainages, and 71% of the variation occurring within populations. Genetic structure was more evident in the Gasconade River with 15% of the variation distributed among populations, compared to 6.5% of the variation in the Meramec River. A principle component analysis (PCA) separated drainages along the first axis and each of the four headwater populations along axes two through 5. The genetic distinctiveness of the headwater populations was also demonstrated in a STRUCTURE analysis. The distribution of genetic variation is consistent with accelerated genetic drift in the headwater populations relative to the large river populations. Future analyses will focus on quantifying migration dynamics among populations within drainages, and seek to identify loci that may be under divergent selection pressures across the river continuum.

63 2:30pm Undergrad

Relationship between Foot Size and Shell Morphology in Two Syntopic Stream-dwelling Snails

*Lauren Brauer, Katrina Whitlow, Paul Brunkow [Southern Illinois University Edwardsville]

Pleurocerid snails represent a very diverse taxon found through the southeastern US which play very important roles in river and stream ecosystems as both consumers and prey. These snails utilize a muscular foot to hold position and move against the constant flow of water; this is one of the most metabolically expensive forms of locomotion in the animal kingdom. The foot thus serves as the functional link between hydrodynamic drag acting on the snail's shell and the animal's ability to hold itself in position for all stages of its life history. The present study examined the relationship between foot size and other morphological features in two syntopic species found in east-central Missouri, *Pleurocera potosiensis* (Prosobranchia: Pleuroceridae) and *P.*

caniculata (Prosobranchia: Pleuroceridae). These species differ significantly in shell shape, range of shell sizes, geographic range, and attachment behavior. The relationship between foot size and body weight did not differ between the two species, although *P. caniculata* grows to significantly larger sizes and thus has larger feet as large adults. Where shell sizes overlap, *P. potosiensis* has a significantly larger body at any given shell size, and thus significantly larger feet. Overall shell shape did not predict foot size in either species after effects of shell size were removed; however, aperture shape was significantly related to foot size in *P. potosiensis* but not in *P. caniculata*. Results suggest that foot size plays a more significant role in determining tenacity in *P. potosiensis* than in *P. caniculata*, which may account for why *P. potosiensis* is present through a greater range of flow velocities.

64 4:00pm Grad

Demography, Habitat Use, and Home Range in the Southern Flying Squirrel (*Glaucomys volans*) in Bluff Forests of Southwestern Illinois

*Loren Dunham, Richard L. Essner, Jr., Peter R. Minchin [Southern Illinois University Edwardsville]

Increased agriculture and urbanization in southwestern Illinois have severely fragmented the once predominant oak-hickory forests of the region. Habitat fragmentation may cause lower species richness, population declines, or extirpation due to phenomena such as edge effects, inbreeding depression, and stochasticity. The effects of habitat fragmentation on suburban wildlife are poorly understood, especially for small mammals such as the Southern Flying Squirrel (*Glaucomys volans*). Previous research indicates that populations of flying squirrels in southwestern Illinois may be declining. Flying squirrels are arboreal rodents whose presence in a forest is indicative of habitat quality, as this species prefers mature and relatively open forest stands. Flying squirrels can be found in the forested areas of the Southern Illinois University Edwardsville (SIUE) campus, as well as in the adjacent Bohm Woods State Nature Preserve. Currently, demographic features of the population and dispersal ability among forest patches are unknown. Study sites consist of 175 randomized plots in four forest patches located within the SIUE campus and Bohm Woods State Nature Preserve, which will be monitored winter 2013 through autumn 2014. Our study will utilize artificial nest boxes and radio telemetry to characterize demographic features of the flying squirrel population, as well as examine movement patterns and home range sizes. Another objective is to identify suitable habitat for flying squirrels by creating a predictive habitat model relating habitat characteristics to presence or absence. The results of this study should provide insight into the effects of habitat disturbance in suburban areas similar to those found in southwestern Illinois and be useful in land use planning.

65 2:30pm Grad

Variation in Lower Limb Bones of White-tailed Deer (*Odocoileus virginianus*) Throughout the Last 10,000 Years in the Central Midwest

*Nathan Reese, Luci Kohn [Southern Illinois University Edwardsville]

White-tailed deer (*Odocoileus virginianus*) are a wide spread generalist species throughout the Americas, with individuals occupying a wide range of habitats.

Over the last 5,000 years, the climate and environmental conditions of the North American Midwest have remained relatively consistent, leading to a period of regularity that would allow environmental selective pressures to act on the species and enabling adaptation to their environment. This study tests for differences in locomotion and body size of white-tailed deer looking at 1) the 3-dimensional form of the calcaneus, 2) astragalus length and depth, and 3) metapodia length and width as they existed through time. Specimens ranging from modern to 10,000 years old from Illinois collections were measured for form variation through time. Measurements of these skeletal elements were recorded using a MicroScribe digitizer and digital caliper. Deer bone dimensions were tested for significant differences between time periods. These differences show adaptations to the changing environment.

66 4:00pm Undergrad Comparison of Shell Morphology and Size Relationships in Two Syntopic Freshwater Snails

*Katrina Whitlow, Lauren Brauer, Paul Brunkow [Southern Illinois University Edwardsville]

Pleurocerid snails display a broad diversity in shell shape and ornamentation. Many pleurocerids have previously been classified according to shell traits; however, recent genetic evidence has shown that many species are more closely related than predicted by morphology. This study examines two syntopic species found in east-central Missouri that have recently been merged into the same genus (*Pleurocera* [=Elimia] *potosiensis* and *Pleurocera caniculata* [=acuta]). These species exhibit widely varying shell shapes and benthic attachment behavior. Geometric morphometrics was used to analyze homologous shell characters and to quantify regions of shape change in relation to multiple measures of size (shell length, centroid size, and body mass). Highest percentage of variation in shell shape was attributed to relative aspect ratio. This shape character displayed a strong relationship with size measures in both species, with larger shells being relatively slender within both species, and there was no overlap in shape between species. Changes in the aperture accounted for the next highest percentage of shape variation within both species. This character was significantly related to size measures in *P. potosiensis*, but not in *P. caniculata*, suggesting a difference in the functional significance of this character between species. These data present an opportunity for further study examining dislodgement performance of live snails in flowing water to examine potential effects of shell shape and attachment behavior on tenacity and geographic distribution. Hydrodynamics of varying shell shapes are also being quantified to examine drag differences that may account for the gap between these species in size/shape space.

67 2:30pm Undergrad Effects of Shell Size and Shape on Hydrodynamic Drag in a Freshwater Snail

*Alexandrea Lewis, Jenna Kunde, Paul Brunkow [Southern Illinois University Edwardsville]

Pleurocerid snails are an important component of stream and river ecosystems as both prey and consumers. Pleurocerids expend high amounts of energy on

pedal locomotion while trying to hold position and move against constantly flowing water. This represents one of the most metabolically expensive forms of locomotion in the animal kingdom, and this energy expenditure may be significantly affected by shell shape and size. Previous studies have explored the relationship between drag and shell characteristics in marine snails; however, no such data have been collected on freshwater snails. The present study investigates the relationship between shell size and shape and hydrodynamic drag experienced by *Pleurocera potosiensis*. Specimens were collected along the length of the Meramec River in east central Missouri, sacrificed, and removed from shells. Shells were photographed and individually mounted to a load cell in a recirculating flume, which allowed measurement of drag as force applied to the load cell. Morphological data were collected from photos, and drag at ten water velocities per shell were measured so that a regression between velocity and drag could be calculated for each specimen. Shell size significantly affected both components of the nonlinear relationship between water velocity and drag, and this relationship was increasingly nonlinear as shell size increased. Across the range of sizes tested, shape had no effect on the relationship between velocity and drag. This occurred despite the fact that a wide range of shell shapes was included in our data set. This is the first study to quantify potential energy expenditure related to drag in freshwater snails. Future studies will further explore how differences in growth rate and shell form between species might affect relationships between velocity and drag.

68 4:00pm Undergrad Effects of Shell Orientation on Hydrodynamic Drag in a Freshwater Snail

*Lucas Winebaugh, Jamal Sahloul, Paul Brunkow [Southern Illinois University Edwardsville]

Stream-dwelling snails play an important role in their communities as both consumers and as prey. Snails also use a unique form of locomotion involving a muscular foot which attaches to and moves across the substrate on a layer of mucus; this is one of the most metabolically expensive forms of locomotion in the animal kingdom. Thus, any factor affecting how much energy must be expended to remain attached to the substrate, such as hydrodynamic drag, can affect the total energetic budget of locally abundant snail populations. The present study examined how orientation of the shell to flow affects the amount of drag experienced by the shell. Single shells were mounted to a load cell in a recirculating flume in four orientations: anteriorly, posteriorly, and in each lateral orientation. Drag was measured at 10 water velocities to obtain the relationship between drag and velocity in each orientation; regression coefficients were compared using repeated-measures ANOVA. Lateral orientations induced significantly more drag than parallel orientations. There was no significant difference in drag when the shell faced either upstream or downstream, counter to expectations that drag would be higher when the spire pointed upstream. Results from this study can be expanded to modeling approaches examining energy budgets and dispersal behavior in stream-dwelling snails.

69 2:30pm

From Five Billion to Zero: An Introduction to “Big Blue,” the Last Extant Passenger Pigeon Killed in the Wild

*David Horn [Millikin University]

The Passenger Pigeon, *Ectopistes migratorius*, was considered to be North America’s most abundant land bird with an estimated population size between 3-5 billion. Passenger Pigeons formed almost inconceivably large nesting colonies and flocks. Nesting colonies contained hundreds of thousands of pairs, and flocks comprised over 1 billion birds. As late as the early 1870s, the Passenger Pigeon was considered superabundant in the Midwest. By 1914, North America’s most abundant land bird was extinct. In 2012, a group of individuals led by J. Greenberg discovered that Millikin University in Decatur, IL owns the last specimen of Passenger Pigeon killed in the wild for which the specimen still exists and there is a record of its death. The male specimen, since named “Big Blue,” was killed in March 1901 near Oakford, IL. It was mounted by O.S. Biggs of San Jose, IL for M.O. Atterberry. Biggs later acquired the specimen and gave it to his daughter Olive. Olive, a 1926 graduate of Millikin University, donated the specimen to Millikin most likely in 1947. The presence of Big Blue is a testament to naturalists spanning over 100 years who had an understanding of the importance of the specimen, took the time to document the finding, and had the expertise to preserve it. There are at least 13 places in Illinois likely named for the Passenger Pigeon. Rather than living at or visiting places named after species that no longer exist, one lesson of the pigeon’s extinction may be that greater efforts are needed to protect current endangered and threatened species.

70 4:00pm Undergrad **Trail Following Behavior and Pheromone Quantification in the American Painted Lady Caterpillar *Vanessa virginiesis* (Insecta: Lepidoptera)**

*Alexandra Berroyer, Marianne Robertson, Casey Watson [Millikin University]

The objective of this study was to determine whether *Vanessa virginiesis* exhibits trail following behavior through the use of a pheromone and to quantify the chemical components of the pheromone. We ran 450 trials with a control group and two experimental groups with caterpillars placed in a T-maze. For the control group, we did not expose caterpillars to pheromones in either arm of the maze. We exposed experimental group 1 to natural pheromones in one arm, and we exposed experimental group 2 to pheromone extract in one arm, leaving the other arm untreated in both cases. We recorded the arm choice of each caterpillar in every trial. We then performed a Gas Chromatograph Mass Spectroscopy (GCMS) analysis of the pheromone extract in an effort to identify its key chemical components. The choices made by both experimental groups were significantly different than those of the control group, indicating that *V. virginiesis* does exhibit trail following behavior through the use of a pheromone. We could not determine the chemical components of the pheromone extraction by GCMS.

71 2:30pm Grad

Behavioral Costs of Tail Loss in the Crested Gecko, *Correlophus (Rachodactylus) ciliatus*, a Non-regenerative Species

*Lauren Mikkelson, David Jennings [Southern Illinois University Edwardsville]

Tail loss (autotomy) is a predator escape mechanism commonly found in lizards, especially geckos. The benefits of autotomy are immediate and well established, as are the benefits of subsequent tail regeneration. In contrast, the costs of tail loss are still poorly understood. The New Caledonian crested gecko (*Correlophus ciliatus*) is able to autotomize its tail, but is unable to regenerate it. It is unique among geckos in this regard and presents the opportunity to study conditions that promote both the evolution of and loss of tail regeneration. Furthermore, loss of regeneration in this species may provide further insights into the costs associated with tail loss. The current work first compares daily behaviors and environment use of tailed versus tailless crested geckos. Additionally, differences in jump performance between intact individuals, recent tail loss individuals, and long-term tail loss individuals will be assessed. The tail plays a major role in maintaining body position and landing in many lizards. Finally, jump performance in Crested geckos is compared to that observed in closely related Gargoyle geckos (*Rhacodactylus auriculatus*). Since Gargoyle geckos regenerate their tails after autotomy, the locomotor costs of autotomy in this species is predicted to differ from the locomotor costs seen in the non-regenerating Crested gecko. Species differences in locomotor costs associated with tail autotomy provide insights into the locomotor costs associated with tail loss, and potentially the costs and benefits of loss of regenerative ability.