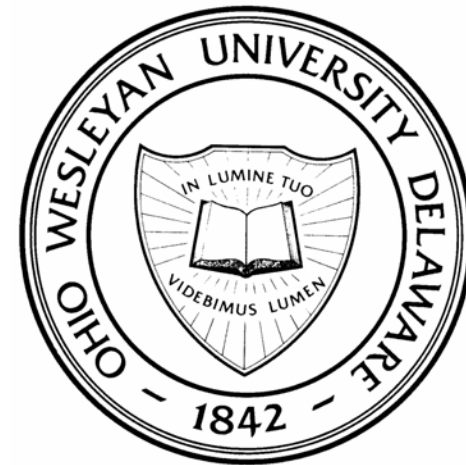


**2005  
SUMMER SCIENCE  
RESEARCH SYMPOSIUM**



**Ohio Wesleyan University  
Delaware, OH**

# 2005 SUMMER SCIENCE RESEARCH PROGRAM



## ACKNOWLEDGEMENTS:

Dr. Richard Fusch  
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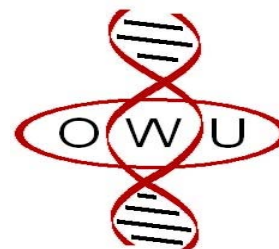
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# SUMMER SCIENCE RESEARCH SYMPOSIUM

Atrium  
Conrades • Wetherell Science Center  
Monday, September 19, 2005



## PROGRAM

### 12:10 – 12:30 Opening Remarks

Dale Swartzentruber  
Interim Associate Dean of Academic Affairs

Mark Huddleston  
President

### 12:30 – 1:30 Poster Session

<sup>1</sup> Jamie L. Harden

<sup>2</sup> Bryan D. Borland

<sup>3</sup> Jessica Brenneman

<sup>4</sup> Juliana M. Mecera

<sup>5</sup> Jackie Hatch

<sup>6</sup> Abigail J. Maley and Jahnvi Purwar

<sup>7</sup> Leah A. Lavelle

<sup>8</sup> Samia Q. Khan and Reeti Khare

<sup>9</sup> Sarah A. Manor

<sup>10</sup> Michael C. Mucher

<sup>11</sup> Karrie Churchwell

<sup>12</sup> Stefan S. Natu

<sup>13</sup> Lauren H. Blyth, Jackie S. Hatch, and Nick T. Reif

<sup>14</sup> Annie Schneider

<sup>15</sup> Sanjay Arora

<sup>16</sup> Jessica Lawrence

<sup>17</sup> Lauren Woods

<sup>18</sup> Yun Kyoung Ryu

<sup>19</sup> Amanda R. Robinson

<sup>20</sup> Sarah Wall

<sup>21</sup> Lindsey Messinger, Hilary Comeras, and Anne Shadle

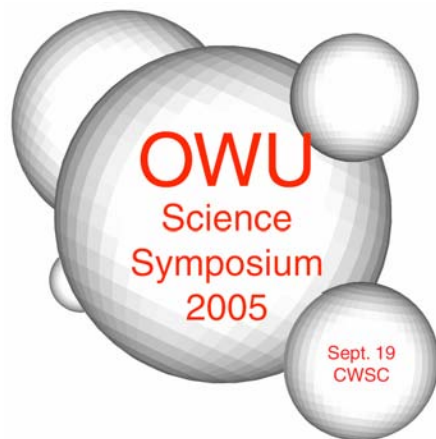
<sup>22</sup> Jessica Walz

<sup>23</sup> Kellie Jaremko

<sup>24</sup> Amy Fabritius

# SUMMER SCIENCE RESEARCH SYMPOSIUM

## 2005 ABSTRACTS



### Poster Session

12:30 – 1:30

#### <sup>1</sup> Jamie L. Harden

Faculty Mentor: Dr. Jerry Goldstein  
Department of Botany and Microbiology

#### **Project Title: Inhibition of Adenovirus Replication by 6-diazo-5-oxo-L-norleucine in Cultured Green Monkey Kidney Cells**

Adenoviruses cause common colds in humans as well as infections of the gastrointestinal tract and the eye. The chemical 6-diazo-5-oxo-L-norleucine (DON) is an antibiotic produced by an unidentified species of *Streptomyces* bacteria and was first isolated in 1956. DON is an analogue of glutamine and competitively inhibits chemical reactions that transfer the amino group of glutamine to other compounds. One such reaction is the production of N-acetylglucosamine and another is the production of nitrogenous bases for nucleotides. Half of the nitrogen atoms in cellular nucleotides synthesized de

novo originate from the amino group of glutamine. In this study green monkey kidney cells were cultured in Waymouth medium supplemented with 5% fetal bovine serum and 5% newborn calf serum in the presence and absence of DON. At a concentration of 5 ug of DON per ml of medium, adenovirus replication was inhibited by 72% whereas a concentration of 10 ug of DON per ml inhibited adenovirus replication by 92%. The presence of 5 mM glutamine reversed the DON inhibition of adenovirus replication by 12%, 10 mM glutamine reversed the inhibition of adenovirus replication by 13%, and 15 mM glutamine reversed the inhibition of adenovirus replication by 27%. This suggests that DON inhibition of adenovirus replication involves glutamine metabolism. The addition of 1 mM of all four nucleosides reversed the DON inhibition of adenovirus replication by 16% and the addition of 5 mM of all four nucleosides reversed the inhibition of adenovirus replication by 86%. This suggests that DON inhibition of adenovirus replication involves the inhibition of viral DNA synthesis. The addition of increasing concentrations of glucosamine had no effect on the inhibition of adenovirus replication by DON. Adenoviruses contain no structural glycoproteins and are not affected by inhibition of cellular glycoprotein synthesis by DON.

#### <sup>2</sup> Bryan D. Borland

Faculty Mentor: Dr. Katherine Hervet  
Department of Chemistry

#### **Project Title: Potential Pharmaceutical Precursors from Functionalized Diaziridines**

Our efforts focused on designing a practical activation method of diaziridines as nitrogen transfer agents to alkenes for the synthesis of aziridines<sup>1</sup>. Aziridines, which are the nitrogen analog to epoxides, possess a similar potential but have yet to become ubiquitous due to the lack of a general aziridination method. There are several anti-tumor and antibiotic natural products, such as mitomycin, porfiromycin, and the FR compounds that contain functional aziridines. Thus, providing a gentle aziridination method that can be used to pursue novel therapeutic agents can greatly aid medicine as bacterial resistance to antibiotics increases.

This summer we investigated the conversion of several substituted aldehydes to their respective diaziridine intermediates<sup>2</sup>. The electronics of the aldehydes and amines were manipulated by altering their substituents to modify the stability of the resulting diaziridine. In addition, the reaction temperatures were varied as well as substrate equivalents. Following completion of each reaction, NMR and IR spectroscopy were performed to analyze the data.

Future analysis will be directed towards analyzing each step of the mechanism with Gas Chromatography Mass Spectrometry (GCMS) as the reaction proceeds from -60 degrees Celsius to room temperature. We hope that through the manipulation of functional groups we can successfully synthesize diaziridines to be used as aziridinating agents. In doing so, we hope to show

that aziridines can be obtained using similar methods and are as useful as the epoxides they emulate.

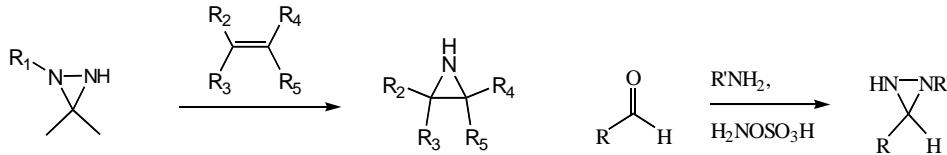


Figure 1

**Figure 1.** Proposed reaction between a functionalized diaziridine and an olefin.

Figure 2

**Figure 2.** Diaziridine formation through use of an aldehyde

### 3 Jessica Brenneman

Faculty Mentors: Ramon A. Carreno and Laura Tuhela-Reuning  
Department of Zoology

#### Project Title: Morphological Analysis of Abursate Nematodes Parasitic in the Lungs of Mammals

Through the use of light and scanning electron microscopy, the morphology of abursate lung worms was studied. *Filaroides martis* specimens were collected from the lung tissue of mink and *Oslerus osleri* specimens were collected from the trachea of a coyote. Specimens were dehydrated in ethanol, critical point dried, mounted on aluminum stubs, and sputter coated with gold. *F. martis* male specimens show a triangular pattern of five papillae surrounding the cloaca with two smaller papillae located directly above the cloaca. The head morphology of *Oslerus osleri* shows six outer papillae surrounding the mouth with two amphids located directly across from one another, behind the central pair of papillae. *O. osleri* males have six papillae surrounding the cloaca in a triangular pattern. Most published descriptions of the morphology of the heads and tails of *F. martis* and *O. osleri* are based solely on descriptions from light microscopy. As a result, the published drawings of these abursate lung worms are either very vague or differ from one publication to the next. The images generated using scanning electron microscopy during this study not only clarify the morphology of the Filaroididae tail, but also demonstrate the importance of scanning electron microscopy when determining the morphology of parasites. Further analysis is required in order to better understand how the morphology of abursate nematodes and bursate nematodes are related, providing evolutionary information on the loss of the bursa.

### 4 Juliana M. Mecera

Faculty Mentor: Laura Tuhela-Reuning  
Department of Botany and Microbiology

#### Project Title: Evaluation of Non-Culture and Culture Techniques for Isolating and Identifying Bacteria from the Plumage of Wild Songbirds and other Surfaces

Feather-degrading bacteria such as *Bacillus licheniformis* have been isolated previously from songbird plumage, but little is known about the varied plumage bacterial species. To better define the microbial communities and individual genera of songbird plumage bacteria, three techniques were utilized: culturing and identification of bacteria, direct observation of bacteria, and extraction of bacterial DNA. First, bacteria were removed from bird feathers using sterile cosmetic applicator swabs then transported to the lab in saline. These saline wash samples were then used to culture over 50 bacterial isolates. The Biolog system was used to identify culturable isolates of *Corynebacterium spp.*, *Corynebacterium jeikeium*, and *Staphylococcus arlettae*. However, many plumage bacteria are unculturable. Unculturable bacteria were observed using direct observation and DNA extraction. To directly observe bacterial cells, bacteria were removed using adhesive tape. Tape samples were then stained using SYTO 9 and propidium iodide and visualized using confocal microscopy. Bacteria could be viewed directly through Fungi Tape without the use of a cover slip. For bacterial DNA extraction, the bacteria in the saline wash from the plumage of two to five birds were concentrated by filtration on a 45 µm pore filter. Bacterial DNA was extracted using Ready-Lyse™ Lysosyme Solution and a modification of the WaterMaster™ DNA Purification kit (both from EpiCentre, Madison, WI). Polymerase chain reaction (PCR) was used to successfully amplify a 650 bp portion of the 16S rRNA gene from the extracted DNA. Amplification was successful in DNA samples obtained from as few as two birds. Furthermore, PCR was most successful using diluted DNA samples (1/10 or 1/100). These PCR products can be used in future work to identify the bacteria present on the plumage.

### 5 Jackie Hatch

Faculty Mentor: Dr. Laurel Anderson  
Department of Botany-Microbiology

#### Project Title: *Alliaria petiolata* population and plant community dynamics of two Central Ohio forests.

*Alliaria petiolata* (garlic mustard) is an established invader of Central Ohio woodlands. This biennial mustard native to Europe displaces indigenous understory fauna. In the Ohio Wesleyan Kraus and Bohannon Nature Preserves, 175 plots (2 m by 2 m) belonging to 23 different transects were

monitored. First-year basal rosettes and second-year flowering stalks of *A. petiolata* were counted and compared to data of previous years. In order to analyze the understory community, we identified plant species, counted individuals, and estimated percent cover in a 1 m by 1 m section of each plot. Counts of *A. petiolata* verified its escalating presence in the Kraus Preserve. *A. petiolata* ranks second at the Kraus Preserve in terms of mean stem density, but does not represent a major portion of the mean percent cover. At the Bohannon Preserve, *A. petiolata* constitutes only a minor portion of both the mean stem density and mean percent cover, indicating that the invasion of *A. petiolata* is less severe at the Bohannon Preserve than at the Kraus Preserve. The plant communities of the two Ohio Wesleyan Nature Preserves were found to be similar, although the Bohannon Preserve demonstrated slightly higher biodiversity. At the Bohannon Preserve, plots containing *A. petiolata* demonstrated considerably lower biodiversity than plots lacking *A. petiolata* while plots at the Kraus Preserve with and without *A. petiolata* were similar in diversity and species composition. This suggests either that the presence of *A. petiolata* alters the species composition and diversity in its immediate plant community or that certain plant community characteristics exist, such as low biodiversity, that make an area more prone to invasion by *A. petiolata*. Further research is needed to investigate this phenomenon, as well as continue monitoring the *A. petiolata* invasion and the plant communities of the Bohannon and Kraus Nature Preserves.

## **6 Abigail J. Maley and Jahnvi Purwar**

Faculty Mentor: Dr. Sarah Leupen  
Department of Zoology

### **Project Title: Reproductive Development in the Salamander: Comparison of Captive and Wild *Ambystoma* species**

Declines in amphibian populations worldwide have brought them to the forefront of conservation concerns. It has been hypothesized that endocrine-disrupting chemicals, or EDCs, which mimic the physiological effects of hormones, might disrupt the reproductive development of amphibians. Although the effects of EDCs on the pituitary and gonadal levels of the reproductive axis have been examined, little work has examined their effects on the gonadotropin-releasing hormone (GnRH) neurons of the hypothalamus, which direct the operation of the entire axis. In order to establish baseline values for EDC studies, we identified and mapped the location of the GnRH neurons in the brain of the axolotl, *Ambystoma mexicanum*. This was done by performing immunocytochemistry on brain slices which were then studied under a fluorescent microscope. Additionally, the presence of GnRH was examined by an *ex vivo* assay in which the hypothalamus of the salamander brain was isolated and maintained in a nutrient-rich medium for three hours. Samples of the solution were taken at 10-minute intervals and assayed for the presence of GnRH. Detectable amounts of GnRH have been found. This work established baseline values against which any perturbations generated by EDCs can be detected.

## **7 Leah A. Lavelle**

Faculty Mentor: N. Kyle Smith  
Department of Psychology

### **Project Title: Priming within the emotional Stroop task: A methodological concern for attention bias researchers**

The attention bias is the tendency to for negative stimuli to automatically attract more attention than positive stimuli (Hansen & Hansen, 1988). One measure of the attention bias, the emotional Stroop task, requires that participants say the color in which negative and positive words are written. Negative stimuli, which attract more attention, distract participants from the color naming task causing participants to respond more slowly (Pratto & John, 1991). However, using positive priming prior to the Stroop task increases attention to positive words, thereby attenuating the attention bias (Smith, Larsen, Chartrand, Cacioppo, Katafiasz & Moran, in press). In addition to this pre-task priming, it is possible that words presented within the Stroop task may themselves act as primes, affecting attention to subsequent words. To test this hypothesis, 44 participants were subliminally primed with either negative or positive words. They then performed a Stroop task which contained a block of positive words and a block of negative words, each followed by negative and positive target words. Analysis of reaction times of these target words showed a significant interaction between target word valence and valence of the preceding block,  $F(1, 43) = 15.97$ ,  $p < .001$ . Following the negative block, there were significantly longer reaction times for negative words than positive words,  $t(43) = 3.84$ ,  $p < .001$ . But, following positive blocks, negative and positive words produced similar reaction times,  $t(43) = -0.86$ , ns. Unlike prior studies, the priming manipulations before the Stroop task had no effect, but the priming blocks within the Stroop task produced results similar to past studies that used prior subliminal priming. This suggests that recent priming manipulations may overwhelm prior priming. Therefore, care must be taken to ensure that attention to negative and positive stimuli are not the result of intertarget priming within the Stroop task.

## **8 Samia Q. Khan and Reeti Khare**

Faculty Mentor: Dr. Danielle Hamill  
Department of Zoology

### **Project Title: Phenotypic and Genetic Analysis of Cell Division Mutants in *Caenorhabditis elegans***

Cell division is a complex process that requires the tight temporal and spatial coordination of numerous proteins. To learn more about this important process, the Hamill lab has identified two cell division mutants in the nematode, *C. elegans*. Both mutations result in early embryonic lethality. *spd (or452ts)* mutants have mitotic spindle defects. Approximately 50% of these embryos fail

to form a bipolar mitotic spindle at the one-cell stage while the rest fail at the two-cell stage. As a result, DNA is not properly separated, and cell division fails. The second mutant, *csc (or576ts)*, has chromosome segregation and cytokinesis defects. The cleavage furrow ingresses, but later retracts, resulting in multinucleated cells. Irregular clearings in the cytoplasm are also observed. We have been using several types of microscopy to further analyze both these mutant phenotypes. Immunofluorescence microscopy was used to show improper segregation of chromosomes in embryos. To analyze spindle components and DNA in living embryos, we are using Green Fluorescent Protein (GFP) as a marker. A previous student began crosses to incorporate GFP linked to tubulin and histone into *spd (or452ts)* mutants. We have continued to build these strains and have begun to analyze their phenotypes. In order to identify the genes that are mutated in these worms, we need to find the location of these genes in the genome. Toward this end, we are using genetic techniques including deficiency and three-point mapping. Based on genetic mapping data and published literature, a previous student in the lab began sequencing a candidate gene for *spd (or452ts)*. We completed this project, but no mutation was found. We will continue mapping and pursue other strategies to identify both the *spd (or452ts)* and *csc (or576ts)* genes.

## <sup>9</sup> Sarah A. Manor

Faculty Mentor: Edward H. Burt, Jr.  
Department of Zoology

### **Project Title: The effects of preening on the microbial community in the plumage of House Sparrows**

In order to gain further knowledge into the relationship between the microbial community found in the plumage and the birds themselves we designed an experiment to determine if and how preening changed this community. We kept a small flock of nine House Sparrows (*Passer domesticus*) in an aviary for four weeks. We fitted five of the birds with plastic cone collars which prevented them from reaching the feathers on most of the body surface, effectively preventing preening. We sampled the flock weekly to determine the number and types of microbes present on each bird. Statistical analysis indicated no significant difference of microbial diversity or abundance between the collared and uncollared birds. This suggests to us that preening actually has no effect on the microbial community within the plumage. We did, however, notice similar changes in the diversity and abundance of the microbial community for the whole flock over the course of the four weeks. This suggests that although preening may not act as a control for the microbes in the plumage this community is as a whole a dynamic ecosystem possibly affected by environmental conditions surrounding the bird.



**At  
work in  
the lab**



## <sup>10</sup> Michael C. Mucher

Faculty Mentor: David Markwardt  
Department of: Zoology

### **Project Title: The Role of RNA Splicing and Regulated Decay in Gene Expression**

mRNA transcripts that contain mutations often have an adverse effect on an organism if the transcript is translated into protein. Eukaryotes have a system termed NMD (Nonsense Mediated Decay) that degrades transcripts containing harmful nonsense mutations known as PTCs (Premature Termination Codons). Nonsense Meditated Decay, originally thought of as only an agent of removal, has gained new interest recently. Initially NMD was believed to target only transcripts containing errors in translation or the DNA itself, but recently a new target group has been identified. These substrates, called natural targets, are genes that contain PTCs not caused by an error but rather ones that are consistently integrated into the gene. Some natural targets include those that are alternatively spliced. Alternative splicing, when coupled with NMD, provides the possibility for a negative feedback mechanism for controlling gene expression. This mechanism, called RUST (Regulated Unproductive Splicing and Translation), would include productive splicing, where a normal transcript is made, and unproductive splicing, where a transcript is made that will be degraded by NMD. The levels of transcript present would influence how the gene itself would be expressed. To investigate this phenomenon, we used the fission yeast *Schizosaccharomyces pombe* for the following reasons:

1. *S. pombe* genome has been recently sequenced
2. There are no natural targets yet identified in *S. pombe*
3. The information on NMD in *S. pombe* is incomplete.
4. *S. pombe* contains more intron-containing genes than *S. cerevesiae*, a more commonly used yeast, which offers the possibility of more splicing events similar to higher organisms.

The *S. pombe* strains we used to investigate NMD included GP1541 (with the ability to perform NMD), and GP1541 $\Delta$ upf2 (without the ability to perform NMD) (Dietz, 2000). These strains needed to be characterized to fully understand the effect of NMD mutations. First we asked if the NMD mutation affected the growth rate and doubling time of the yeast. A growth curve was plotted, and the two strains were found not to be significantly different in their growth rate. We next asked if the inability to perform NMD affected the levels of a transcript containing a PTC. From Northern blots, preliminary research found this to be true but more investigation is needed. Finally, some natural targets in other organisms (SPE1, SPE2, and SPA1) were investigated in *S. pombe*. After using RT-PCR (Reverse Transcription-Polymerase Chain Reaction), we found no evidence of unproductive splicing in these genes in *S. pombe*.

In the future, the RNA from *S. pombe* will be analyzed in a microarray. A microarray will allow us to look at gene expression levels between the strains on a genomic scale. This microarray and the data derived from it should help us find natural targets in *S. pombe*.



## <sup>11</sup> **Karrie Churchwell**

Faculty Mentor: Dr. Vicki DiLillo  
Department of Psychology

### **Project Title: The Effects of Acute and Chronic Stress on Pain Perception**

Pain is a significant health concern. Strategies such as exposure to acute stress and various distraction techniques may reduce experimentally induced pain. However, no studies to date have examined the joint effect of these strategies on pain perception or related physiological measurements such as blood pressure (BP) and heart rate (HR). Furthermore, the effect of chronic stress in this context has been neglected. This study investigated the effects of stress (acute and chronic) and distraction on pain perception and cardiovascular measures (CVM). Thirty-nine healthy college students ( $M$  age = 20 years 8 months) participated. Participants were 72% female, 87% white. Participants were randomized to an acute stress (public speaking) or control task condition. Participants then performed the foot cold pressor (CP) task; half completed a distraction exercise during the CP. BP and HR were measured throughout the session. Pain ratings (early, middle, and late task; maximum) and pain threshold were assessed during the CP. A series of 2 (acute stress: public speaking vs. nature task) X 2 (distraction vs. no distraction) ANOVAs revealed neither main nor interaction effects for pain measures ( $F_s < 1.09$ ,  $p_s > .30$ ). A main effect for acute stress was seen for systolic BP reactivity to the CP ( $F = 12.79$ ,  $p = .002$ ). Effects of acute and chronic stress on pain and CVMs were investigated with 2 (acute stress: public speaking vs. nature task) X 2 (high vs. low chronic stress) ANOVAs. With the exception of pain threshold, significant acute X chronic stress interactions were seen for all pain measures ( $F_s > 7.35$ ,  $p_s < .01$ ). For CVMs, only a main effect for systolic BP was observed ( $F = 10.96$ ,  $p < .001$ ). Results suggest that exposure to acute stress may attenuate pain sensitivity when chronic stress is high, but that under conditions of low chronic stress, exposure to acute stress may instead enhance the perception of pain.

## <sup>12</sup> **Stefan S. Natu**

Faculty Mentor: Dr. Brad Trees  
Department of Physics and Astronomy

### **Project Title: Synchronization of a Coupled Josephson Junction array and Micromechanical Oscillator.**

Our summer research project involved studying the dynamics of a serial array of Josephson Junctions coupled to a nano-mechanical resonator and a current source. Small length scales mean that quantum mechanics was needed to describe the behavior of the system. We began by studying the classical

Hamiltonian, a mathematical function that gives the generalized equations of motion of a system for a single junction in parallel with a current source and resonator. We then converted the variables in this Hamiltonian to operators and used Heisenberg's operator equation to produce the resulting quantum equations of motion. The equations were imported into our FORTRAN 90 code and solved using a fourth order Runge-Kutta technique. The computer code was used to calculate the time average voltage across the junction with respect to the external current in the current source. Next, we generalized this to a series of N junctions coupled to the current source and resonator. N was set at 10. The numerical data indicated that as the current decreases, it reaches a value where all of the junctions go into synchronization with the resonator. This means that the junctions are moving in phase and at the same frequency as each other and also the resonator. We observed that the value of the average voltage at which synchronization occurs is close to the natural frequency of the resonator in the limit of weak coupling between the resonator and the array. On increasing the current again the junctions showed a strong tendency to remain in synchronization. This was indicated graphically by a flat step in the plot of the average voltage across the array versus the value of the bias current. We also studied the stability of the step. We perturbed the variables in our equations to obtain the equations for the perturbations. These equations were solved to produce Floquet multipliers, which are indicators of stability. We discovered that the stability is heavily dependent on the coupling between the array and the resonator and capacitance of both the junctions and the resonator. We were able to obtain regions where the step is stable. Lastly we attempted understand how the step occurred near the natural frequency of the resonator. We were able to make analytical headway on our equations for the regions where the step was stable. This gave us insights into the nature of the step and provided an equation dependent only on external parameters, with which we were able to predict the location of the step with excellent precision.

This project is interesting because recent advances in micro technology have made it possible to fabricate these micromechanical oscillators. Furthermore, micromechanical oscillators and Josephson junctions are strong candidates for quantum bits, the building blocks of modern quantum computers.

## <sup>13</sup> **Lauren H. Blyth, Jackie S. Hatch, and Nick T. Reif**

Faculty Mentor: Laurie Anderson  
Department of Botany and Microbiology

### **Project Title: White-tailed Deer (*Odocoileus virginianus*) as Dispersers of Invasive Plants**

There is no dispersal mechanism to account for the rapid spread of invasive *Alliaria petiolata* (garlic mustard) observed in eastern deciduous forests. The long-distance dispersal abilities of white tailed deer (*Odocoileus virginianus*) through endozoochory were examined in field and greenhouse studies in an effort to identify a dispersal mechanism for garlic mustard, and to determine if other Central Ohio species are dispersed by deer. Scat was collected in



Delaware County, Ohio from September 2004 through July 2005. After cold stratification, scat was either broken apart and mashed or planted as intact pellets in the greenhouse in order to estimate the numbers and species of viable seed present in the scat. We investigated germination in a more natural field study by monitoring the plant communities around scat covered by chicken wire cages, adjacent cages without scat, and uncaged sites. Scat planted in the greenhouse produced germinants of over 21 species, two of which are invasive. No garlic mustard germinated. Significantly more individuals and species germinated from mashed than intact pellets; however, speed of germination was not affected by this treatment. Plant community diversity in caged scat plots was similar to nearby caged and uncaged sites, suggesting that no unique species had germinated in the scat plots. Decay rates of deer scat in the field varied greatly, with an average of 25 days. Rates increased as the spring progressed, suggesting that higher temperatures increased the rate of this biological process. Our data suggest that deer are capable of dispersing a number of different plant species, and that scat decay facilitates germination for many of these. However, given the similarity of plants found in sites with and without scat, the importance of deer as dispersers in nature remains unclear.

#### **14 Annie Schneider**

Faculty Mentor: Dr. Robert Harmon  
Department of Physics and Astronomy

#### **Project Title: Mapping the Surface of Pluto via Light-curve Inversion**

Ever since its discovery in 1930, Pluto has presented scientists with a great challenge. It is only 2/3 the size of Earth's moon, so that because of its great distance Earth-based telescopes render it as an unresolved point of light. Even the Hubble Space Telescope produces an image which is only a few pixels across. Nevertheless, it is possible to deduce the presence of light and dark spots on the surface based on variations in Pluto's brightness as it rotates with a 6.3872-day period. Thus, we use an indirect imaging method, light-curve inversion (LI), to generate surface maps of Pluto based on photometric light curves (plots of brightness versus time). LI was first applied to Pluto by Drish *et al.* (1995, Icarus 113, 360-386) using light curves obtained from 1954 to 1986. We extend this work by including additional light curves up through 1999. Pluto's light curve varies over time for two reasons. First, as Pluto's distance from the Sun changes, surface temperature variations may lead to volatile transport, thus changing the appearance of the surface. In addition, the angle between Pluto's rotation axis and the line of sight to Earth changes as Pluto orbits the Sun. As a result, we look down on different latitudes on Pluto's surface, and thus different surface features. Since a given feature has a maximum effect on the light curve when it passes directly through our line of sight, we gain valuable insight into the latitudes of surface features by utilizing light curves obtained at widely separated times. Eventually, we hope to include

a light curve obtained in 1933 (these data are not yet publicly available) and our own light curve from data collected at Ohio Wesleyan's Perkins Observatory.

#### **15 Sanjay Arora**

Faculty Mentor: Dr. Robert Kaye  
Department of Physics and Astronomy

#### **Project Title: Lifetimes in the Strontium-79 Nucleus**

The initial goal of the project was to study the energy-level structure of the  $^{60}\text{Zn}$  (Zinc-60) nucleus experimentally. To achieve this, an experiment was conducted at the Florida State University Superconducting Linear Accelerator Laboratory. Due to technical difficulties, the  $^{60}\text{Zn}$  experiment was unsuccessful and a new experiment was carried out to look for  $^{71}\text{Se}$  (Selenium-71) nuclei. This experiment was successful but the short duration of the research program made it impractical to analyze all the data. The project was changed and lifetimes of excited nuclear states were studied in the  $^{79}\text{Sr}$  (Strontium-79) nucleus using an existing data set. In the course of the experiment, data about the gamma-ray emissions from the  $^{79}\text{Sr}$  nucleus were collected. These data were used to measure the lifetimes of states in the energy-level scheme of the nucleus. These lifetimes were used to calculate the degree of deformation. Deformations gave a quantitative idea of the shape of the nucleus as a function of angular momentum and excitation energy. Finally, a theoretical calculation of the deformation was carried out and the experimental and theoretical results were compared. It was seen that the experimental values agreed well with the theoretical values and the nucleus was highly deformed, as predicted by theory.

#### **16 Jessica Lawrence**

Faculty Mentor: Dr. Karen Fryer  
Department of Geology and Geography

#### **Project Title: Identification of Heavy Minerals in Stream Sediments from The Kraus Wilderness Preserve**

The analysis of heavy minerals in stream sediments can provide information concerning sediment provenance. The origin of the sediments is interpreted by comparing the sediment phases and composition with possible source rocks. Samples were collected in point bars and on banks that were directly adjacent to the stream in Ohio Wesleyan University's Kraus Wilderness Preserve. The heavy minerals make up 7-10% of the collected samples. Separation of the heavy minerals was done using Sodium Polytungstate (NaPT), which is a heavy liquid. The heavy minerals were then put onto slides and ground to 33 microns for proper identification. The stream sediments were identified by a petrographic microscope with transmitted and reflected light, and compositions were determined using the Scanning Electron Microscope and Energy Dispersive Spectrometer. In the sediments we found two distinct amphiboles

(calcium-iron-magnesium and iron-magnesium), garnet, pyrite, magnetite and ilmenite. This research may be extended to Ohio Wesleyan's Bohannon Nature Preserve as well as some other streams around central Ohio.

## 17 Lauren Woods

Faculty Mentor: Amy Downing  
Department of Zoology

### **Project Title: Temporal variability of plankton in four Southern Michigan ponds**

Ecologists have long appreciated how ecosystems, and the composition and abundance of species within ecosystems, vary temporally. However, observational studies that carefully document this temporal variability are rare, particularly at the level of individual species abundances. To explore patterns of temporal variability, we sampled four ponds in Southern Michigan from the months of May through August. Although located within 4 km<sup>2</sup>, these ponds differ in size, average productivity, and plankton species composition. In order to obtain detailed information on temporal variability, ponds were sampled every five days for zooplankton and phytoplankton abundance. We also measured average daily pond productivity and daily temperature fluctuations. We found that individual species display distinct dynamics, and their abundances vary greatly through time. In addition, each pond revealed unique temporal dynamics of zooplankton and phytoplankton abundance. Detailed studies like these will help us understand how ecosystems, and the species within them, might respond to natural or human-caused environmental disturbances.

## 18 Yun Kyong Ryu

Faculty Mentor: Jann M. Ichida, Biosafety Officer  
Department of Environmental Health and Safety, Academic Affairs Office

### **Project Title: Bacteria at our Fingertips: Lurking on Handles, Doors Knobs, Keyboards & Railings**

Bacteria are ubiquitous on environmental surfaces. Most are denizens of our normal flora and can be beneficial. A few bacteria can cause disease, and contagious infections can be spread by oral ingestion, inhalation or contact with fomites or injections by sharps or insects. Concern about spread of disease from touching common surfaces is a public health issue with policy focusing on a hand washing campaign to insure better hygiene. The public areas and toilets at a university host a great variety of people during the summer weeks of open houses, camps, research programs and events. The lavatories of two buildings at a private university were swabbed and surfaces sampled over a three week period of heavy use. Toilet handles, stall doors, faucets, towel dispensers and door bars were tested for bacteria with a focus on fecal coliform

isolation. Additionally, common-use computer keyboards were sampled in the atrium of the science center. Dacron swabs were rolled on the surface and plated on general media (Tryptic Soy Agar, Sheep Blood Agar and Chocolate agar) for total bacteria counts. Selective media (MacConkey, EMB, Malt Extract) were used for fecal bacteria and molds. Contact plating was also done on these surfaces using paddles with selective and nonselective media. Of the 27 bathroom stalls sampled, most had no fecal bacteria and only normal skin bacteria and common soil or dust microbes isolated. Total counts indicated that adequate housekeeping cleaning had been done to remove any gross contamination. The computer keyboards were, however, extremely colonized with bacteria and fungi. The surface was visually dirty. Swabs and contact plates grew bacteria of many genera including suspect fecal bacteria. Follow up disinfection with benzalkonium chloride wet wipes was very efficient in decontaminating and cleaning the computer keyboards. Good hand washing practices after using the toilet are effective in reducing the bacterial load on doors and lavatory fixtures. Better hand hygiene and surface cleaning is needed at computer stations to insure less spread of communicable disease agents.

## 19 Amanda R. Robinson

Faculty Mentor: Jane E. Dorweiler  
Department of Biological Sciences  
Marquette University

### **Project Title: Differential gene expression of delayed flowering and tasselseed phenotypes in *Zea mays mop1* mutants**

Genes involved in flowering have not been well studied in the monocot *Zea mays*. In well-studied dicot models such as *Arabidopsis thaliana*, various floral activators and repressors interact to influence the gradual change from vegetative to reproductive growth. In maize, a recessive mutation in the gene *mop1* causes a five to seven day delayed flowering phenotype. MOP1 protein is also believed to play a role in chromatin remodeling. Chromatin remodeling could be used to control accessibility of flowering genes for transcription. Another aberrant phenotype appearing in *mop1* mutant plants is a feminization of the male inflorescence, or tassel, resulting in the development of kernels known as "tasselseed". Interestingly, if maize is over-stimulated with the plant hormone gibberellic acid it will also develop the tasselseed phenotype. Maize genes homologous to Arabidopsis floral activators, floral repressors, chromatin remodeling genes and genes involved in tassel development were therefore studied using quantitative real time PCR for differential gene expression in *mop1* mutants. Maize homolog *gai* (*gibberellic acid insensitive*), homolog *SPY* (*spindly*) and the maize gene *IDS* (*indeterminate spikelet*) showed increased expression in *mop1* mutants compared with the wild type. Decreasing expression levels as tassel size increased was observed in *SPY*, *IDS* and the maize homolog *AGL20* (*AGAMOUS LIKE 20*). These data provide further insight to the function of MOP1 protein and genes involved in the floral development of maize.

## 20 Sarah Wall

Faculty Mentor: Kim A. Lance  
Department of Chemistry

### Project Title: Design and Synthesis of Manganese(III) $\alpha$ -Dioxime Complex.

We wish to report the synthesis and characterization of a novel manganese(III)  $\alpha$ -dioxime complex (Figure 1). The metal-free ligand was synthesized using copper(II) as a sacrificial metal via a reaction with potassium cyanide. The manganese(III) complex was subsequently reacted with manganese(III) acetylacetonate and potassium chloride in acetonitrile. Full characterization of the copper(II) complex, the metal-free ligand and the manganese(III) complex will be presented.

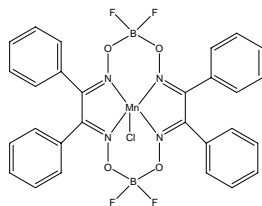


Figure 1

## 21 Lindsey Messinger, Hilary Comeras and Anne Shadle

Faculty Mentor: Dr. Bahrick, Dr. Hall and Dr. Baker  
Department of Psychology

### Project Title: Cognitive Aging and Accessibility of Spanish Vocabulary

The goal of this project was to explore the age-related diminution of access to Spanish vocabulary words and the effectiveness of methods of restoring lost access to that knowledge. Twenty-seven young (18-25 years), 57 middle-aged (40-55 years) and 33 older adults (70-85 years) participated. All participants completed two or more years of Spanish in high school or college.

The test consisted of 120 recognition items and 128 recall items, with one half of each type being nouns and half being verbs. All Spanish words would have been learned in the first two years of study. The relative difficulty of words was equated on the basis of prior recognition data. For recall items, a participant was presented with the English word and asked to type its corresponding foreign language word. If a response was incorrect, the participant was given one of three feedback conditions: (1) no feedback, (2) entire word (participants were shown the entire correct answer) and (3) sequential letter (participants were shown letters one-by-one until the word was correctly recalled).

Participants were retested on recall items after an interval of 30 minutes, one day, seven days or 30 days.

We examined the proportion of items correctly recalled on test two out of those failed on test one as a function of age group, type of feedback, and inter-test interval. Generally, participants recovered more items with feedback than without, and they recovered more with sequential letter than entire word feedback. The benefit from sequential letter feedback appears strongest for the older adults. As the length of inter-test interval increases, participants recover more words spontaneously, i.e., with no feedback. However, the benefit of viewing feedback declines.

The continuing goal of this research is to diagnose age related problems of accessing available knowledge and to develop strategies that will help maintain access to what we know.

## 22 Jessica Walz

Faculty Mentor: Dr. Ted Daeschler  
Department of Paleontology: Academy of Natural Sciences,  
Philadelphia, PA

### Project Title: Bothriolepid Placoderms from the Nunavut Paleontological Expeditions: A Comparative Analysis

Expeditions to the Canadian Arctic in 1999, 2000, and 2002 involved the excavation of vertebrate fossil material. During 1999, various work sites were established on Melville Ile Vanier Islands, and in 2000 and 2002 excavation sites were established on Ellesmere Islands. Fossil material included placoderm fish fragments from the Late Devonian Period which can be divided into the Frasnian and Famennian ages. Previous stratigraphy indicated that those fossils collected in 1999 were derived from the early and middle Famennian deposits of the Parry Islands Group, as well as from the early Frasnian deposits of the Beverly Inlet Formation. Fossils collected in 2000 and 2002 were derived from the middle and late Frasnian deposits of the Okse Bay Group. The primary family of Placodermi fish fossils that were collected throughout the Nunavut Expeditions belonged to the family Bothriolepidae. Fragmentary pieces of head and trunk armor were identified through comparison to previously named elements. In order to document the diversity of Bothriolepid forms within the Nunavut region, a catalog was created consisting of an analysis of the various elements' unique characteristics such as surface ornament, size, shape, and the presence and location of sensory lines. Elements within a specific site were grouped together and given informal names, which were then used to make correlations between field sites as well. Based on similarities in plate characteristics, those forms that correlated indicate the necessity to redefine the previously excepted stratigraphy. More specifically, results indicate that some forms from Parry Islands' Cape Fortune Formation mapped as early Famennian age may belong lower in the geologic time scale, the Middle Frasnian age. Also, some forms from Parry Islands'

Consett Head Formation of the Middle Famennian age may belong lower in geologic time scale, the Late Frasnian age. However certain correlations simply confirmed the accuracy of the previously accepted stratigraphy. This was indicated based on the correlation of lower Beverly Inlet Formation and Fram Formation across a wide geographic area. Finally, it was demonstrated that certain Nunavut forms also correlate with named species from Eastern Europe. Some of the smallest Nunavut forms have similar plate characteristics to *B. prima* and *B. Evaldi* of Eastern Europe. Finally it was determined that the largest form excavated from the Nunavut expeditions most likely can be named as a separate species than *B. maxima*, the largest named European form, based on significant differences in plate size and thickness. However more detailed comparative analysis between Nunavut and East European forms is necessary to confirm this preliminary analysis.

## <sup>23</sup> Kellie Jaremko

Faculty Mentor: Dr. John Moore and Dr. Vishal Pandey  
Department of Neonatology at Cleveland Metro Health Center affiliated with Case Western Reserve University

### **Project Title: Comparison of Repetitively Stretched Human Fetal Membranes from Spontaneous Vaginal Deliveries and Caesarian Sections**

Originating in the placental disk, extra-embryonic tissues enclose the fetus in *vivo* and are referred to as human fetal membranes (FM). Rupture of these membranes is an integral part of labor, in both term and preterm deliveries. FM weaken as a result of apoptosis and remodeling of its main structural foundation, collagen. This is both a biochemical and developmentally regulated process. The stretching that these membranes endure throughout labor is thought to further undermine their stability. This process in its entirety is not well understood.

In order to examine the effect of stretch on fetal membrane physical properties we cyclically stretched intact pieces of FM and then compared them with topologically adjacent, un-stretched (control) FM pieces. FM pieces were stretched to 50% or 75 % of the determined rupture strength (RS) of adjacent control pieces, for 10, 15 or 20 cycles of 10 seconds per cycle. The physical properties of FM were determined utilizing modified industrial membrane rupture testing equipment (Com-Ten industries). Rupture Strength (RS), Work to Rupture (WR), and Stiffness at Rupture (SR) measurements were determined from the force vs. deflection curves generated using this equipment.

Stretching significantly altered the physical FM properties that were observed. In FM obtained after both vaginal delivery and Cesarean Section (without labor), pre-stretch caused an increase in both FM rupture strength and FM stiffness, but a decrease in work to rupture. With continued cycling rupture strength also decreased markedly in vaginal deliveries, unlike their caesarian counterparts. Increased rupture strength, stiffness and decreased work

following repetitive stretching may be due to collagen fiber realignment along the lines of stress. This is observed in other soft tissues where tensile loads cause collagen fiber uncrimping and reorganization, allowing the straightened collagen fibers to become the primary load-bearing elements. This may be a protective mechanism preventing precipitous rupture of FM.

We speculate that the differences seen in vaginal vs. Cesarean delivered FM, may be the result of stretch-induced, gene activated biochemical remodeling, associated with labor in the former, which has yet to occur in the latter.

## <sup>24</sup> Amy Fabritius

Faculty Mentor / Colleagues: Victoria Henderson, Jenifer Soto, David Derkacs, Angela Schwendiman, Priyanka Shah, Catherine R. Propper.  
Northern Arizona University, Department of Biological Sciences, Flagstaff, AZ 86011

### **Project Title: Gonadal differentiation and baseline behavior in tiger salamanders raised in wastewater.**

Numerous natural and synthetic compounds have the ability to disrupt the natural functioning of endocrine systems in all animals. Even in very low doses often present in water, these endocrine disrupting compounds (EDCs) can mimic or inhibit numerous hormones, often interfering with normal physiology, especially during development. We looked at behavior and sex ratio in a wild population of tiger salamander (*Ambystoma tigrinum*) larvae collected from treated water at the wastewater facility in Sedona, AZ to determine changes in behavior following predator-simulated challenges, and sex ratios. Animals were tested for general activity and response to an artificial predation event. Following behavioral testing, all animals were euthanized, weighed and SVL measured. The gonads were exposed and photographed, then removed with the kidney for histological examination. There were no significant trends in the behavior due to high variability among individuals. The sex ratio with this sample was not skewed. This result suggests that the water in which these animals were raised does not influence gonadal development and may not have steroidogenic or antisteroidogenic activity.



**At  
work in  
the lab**

