Ohio Wesleyan University

Patricia Belt Conrades » Summer Science Research Symposium



September 17, 2007

Dr. Herbert DuPont ’61 »

Chief of Internal Medicine, St. Luke’s Episcopal Hospital

“Research is the basis for all new knowledge. It is creative and fun, and turning students onto research is exciting. The Summer Science Research Program has stimulated interest in science and international health among the participants, and many have gone on to distinguished careers in science, medicine and public health.”

The Patricia Belt Conrades Summer Science Research Symposium

Science, mathematics, and technology touch all of our lives. Through ongoing research and discoveries concerning worldwide problems such as infectious diseases, air pollution, gene therapy, and global warming, we can tackle such issues and train today's students to be tomorrow's accomplished scientists.

Now in its 15th year at Ohio Wesleyan, the Patricia Belt Conrades Summer Science Symposium—so named just last year to honor long-time alumna and Trustee Patricia Conrades '63—encourages engaged research and learning within a 10-week period. This culminates in a symposium allowing students to proudly present their research in poster format at a gala event in the atrium of our Conrades•Wetherell Science Center.

During summer 2007, a total of 35 OWU students and five off-campus students participated in research with their faculty mentors on OWU's campus or in off-campus research opportunities at other universities. We present these special students and their research within the proceedings.

Contents »

Atrium, Conrades•Wetherell Science Center

Monday, September 17, 2007 at noon

Opening remarks by OWU Interim President David Robbins followed by student poster presentations at 12:10 p.m.

Thoughts from the Director

The Summer Science Research Program has just concluded its 15th year at Ohio Wesleyan University and continues to capture the essence of the OWU experience: rigorous academics, and close student working relationships with faculty.

This particular program provides students the unique opportunity to explore their interests and passions in science by conducting cutting-edge research side by side with our talented faculty over a 10-week period during the summer. At the conclusion of the summer program, students share their experiences with others in our community by presenting posters summarizing their research at the Patricia Belt Conrades '63 Symposium. The symposium, funded by an endowment provided by Dr. Nancy Reynolds Schneider '64, prepares our students for the real world by giving them experiences comparable to what they will experience at professional scientific meetings.

In addition to the one-day symposium in the fall, students present their research findings to one another at luncheons throughout the summer program and are encouraged to present their research to other students and faculty who are not part of the program in podium talks at departmental seminars throughout the academic year. Many of our students also present their research along with that of their faculty mentors at professional scientific meetings and have their work published in major scientific journals. This provides further opportunities for our students to gain critical experience in presenting data at scientific venues and to become recognized by the larger scientific community.

While our Summer Science Research students receive small stipends and supply budgets for their work, it is the one-on-one contact with faculty mentors and fellow student researchers from Ohio Wesleyan as well as elsewhere that is of ultimate value and importance as our students' science educations develop and unfold.

In the following pages you will also be introduced to several of our Symposium researchers and students who conducted science research at off-campus locales during this past summer as well as students from other colleges who conducted research on our campus under a National Science Foundation (NSF) Research Experiences for Undergraduates (REU) Grant awarded to our faculty in physics, astronomy, computer science, and mathematics.

Celebrate with us the accomplishments and discoveries of our students—the innovative leaders and scientists of tomorrow.

David Robbins
Interim President of Ohio Wesleyan University

The Making of a Scientist

The Ohio Wesleyan Summer Science Research Program offers students the opportunity to move out of the relative comfort zone of the classroom lab and into the research lab.

Students learn quickly that research is quite different than classroom labs—more challenging, more creative, more frustrating, more rewarding.

I have been involved with summer research at OWU since my arrival here 10 years ago. While I find my research exciting and interesting, I particularly enjoy the challenge of working with a student on a research project and seeing the student eventually take ownership of the project. During this process, the student becomes a scientist—thinking, acting, and speaking like a scientist. Research is an essential part of being a scientist, and we at Ohio Wesleyan prepare our students for research success in both on-campus research opportunities and at research at other universities.

During the Symposium this afternoon, you will have the opportunity to interact with 27 students who performed research at OWU this summer mentored by OWU faculty members, five students from universities other than OWU who worked on campus with OWU faculty, and eight OWU students who performed research off-campus at other universities or in other countries. There is no doubt that the research results presented here today are exciting and novel. However, equally as exciting is the opportunity for you to speak with and interact with these 40 young scientists.

Enjoy the Symposium and be sure to learn something new!

Laura Tuhela-Reuning
Department of Botany and Microbiology
Department of Zoology
Scanning Electron Microscopist
Summer Science Research Program Events Coordinator

Patricia Belt Conrades ’63 is a volunteer registered nurse and homemaker, and a member of Ohio Wesleyan’s Board of Trustees. She regularly assists in the operating room of Boston’s Mt. Auburn Hospital, also serving on the Women’s Auxiliary Advisory Board.

Mrs. Conrades is an avid gardener and has served as Vice President of the Boston Junior League Garden Club, winning numerous awards for flower arranging. She has displayed her work at the Boston Museum of Fine Arts.

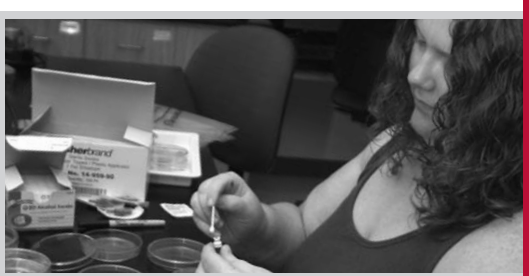
Married to George Conrades ’61, a member of OWU’s Board of Trustees, Mrs. Conrades is mother of Liza, Laura ’88, Gus (deceased), Emma, and Anna ’03, and has been honored for her interest in promoting women in the sciences and for her own accomplishments as a nurse. In addition, Mrs. Conrades recently was honored with a gift of recognition by her long-time friend and fellow OWU alumna, Dr. Nancy Schneider ’64. Instrumental in the successful creation of the Conrades. Wetherell Science Center, the Conrades’ support continues to strengthen the science and mathematics programs at OWU.

Dr. Nancy Schneider ’64 is a Phi Beta Kappa graduate of Ohio Wesleyan, and has been a highly regarded Professor of Pathology and Director of the Cytogenetics Laboratory on the faculty of the University of Texas Southwestern Medical Center in Dallas.

She has published broadly, with emphasis on the cutogenetics of childhood cancer. Dr. Schneider has been an invited member of the Pediatric Oncology Group Cytogenetics Committee, a consortium of about 100 major childhood cancer treatment centers. Her research interests focus on constitutional and acquired chromosome abnormalities of neoplastic cells.

A loyal and caring alumna of Ohio Wesleyan, Dr. Schneider is a member of Ohio Wesleyan’s Board of Trustees, and received the Distinguished Achievement Citation award from OWU in 1999. To recognize the University’s strong science and mathematics program, acknowledge the importance of women in the sciences, and in honor of a special friend and fellow OWU alumna Patricia Belt Conrades ’63, Dr. Schneider established an endowment to name the Patricia Belt Conrades Summer Science Research Symposium at Ohio Wesleyan. Says Dr. Schneider:

> *“It is most appropriate that this symposium, which so importantly exhibits and encourages student development and achievement, should be named for Patsy, whose energy, courage, devotion, and seriousness of purpose inspire all who know her.”*



Board 1

Tiffiny Rye

Faculty Mentor: Dan Vogt
Department of Chemistry

Sickle cell anemia is a genetic disease in which mutated hemoglobin aggregates (forms fibers) when it deoxygenates (releasing the oxygen it is carrying). This aggregation causes the red blood cells to become distorted into a sickle shape that gives the disease its name and leads to the pathology of the disease. The purpose of the research was to synthesize and test a compound, bis (4,6-dibromo-3, 5-dichlorosalicyl) fumarate, to determine if it could cross the red blood cell membrane and chemically crosslink the beta subunits of hemoglobin thereby inhibiting the sickling phenomenon (by restricting the movement of the beta subunits) when the hemoglobin deoxygenates. The ultimate goal of this project is to develop a drug that can be orally administered to patients suffering from sickle cell anemia.

Synthesis and Testing of Bis(4,6-dibromo-3, 5-dichlorosalicyl) Fumarate for the Chemical Modification of Hemoglobin

Bromine was reacted with 3,5-dichlorosalicylic acid in the presence of 65% oleum to yield 4,6-dibromo-3,5-dichlorosalicylic acid. NMR of the product showed no aromatic protons indicating a successful reaction. This tetrahalogenated salicylic acid was reacted with fumaryl chloride in the presence of N,N dimethyl aniline and benzene in a linkage reaction resulting in the formation of bis(4,6-dibromo-3,5-dichlorosalicyl) fumarate. NMR showed the linkage was successful with a peak at 3.1 ppm corresponding to the fumaryl hydrogens. Mass spectroscopy confirmed the fumarate product was successfully isolated with a peak at 832 m/z corresponding to the parent ion plus sodium. Cell free hemoglobin and hemoglobin in whole blood cells were reacted with 5 mM bis (4,6-dibromo-3,5-dichlorosalicyl) fumarate at 37˚C. The extent of crosslinking of the beta subunits was determined by SDS-PAGE. Treatment of cell free hemoglobin resulted in nearly 100% crosslinking. Treatment of the whole cell samples resulted in significant hemolysis (approximately 60%) with the hemoglobin from the lysed cells showing nearly 100% crosslinking while the remaining intracellular hemoglobin was not significantly modified.

Board 2

Rachel Fleming

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

This summer I examined several needle-less access devices commonly used to administer drugs and other solutions through IV systems. A new device, the Q-Syte™, was developed to reduce the risk of bacterial contamination compared to currently used models such as the CLAVE® and SmartSite®. Tests were run to compare the number of bacteria able to get into and pass through each device as well as to determine if the Q-Syte™ could remove or burst bacterial cells when a syringe tip was passed through the device. Results show that the Q-Syte™ allows more bacteria to get into and pass through the device than other models currently used.

Mechanical Anti-infectivity: Comparison of Bacterial Contamination Risk Associated with Several Needle-less Intravenous Access Devices

Several needle-less access devices are currently used in hospitals to administer various solutions through intravenous (IV) catheters. These devices may allow more bacterial contamination compared to previous use of a needle and septum. A new device, the Q-Syte™, was developed to further reduce the risk of bacterial contamination. A combination of microbiology and microscopy was used to compare the Q-Syte™ to the SmartSite® and CLAVE® through contamination with *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The Q-Syte's™ ability to prevent contamination was tested by passing the tip of a luer syringe through the Q-Syte™. All devices were then compared through controlled contamination of the surface followed by access with a syringe filled with 5% dextrose IV solution. Device surfaces were cleaned and accessed at later time points to determine if bacteria had been able to grow and reproduce inside any of the devices. All liquid samples were collected and cultured in trypticase soy agar to quantify the number of bacteria in each device at each time point. Scanning electron microscope (SEM) images of luer tips and Q-Syte™ septa from the first experiment and device interiors from the second were used to support these findings. Results indicate both luer tips grown in broth culture as well as Q-Sytes™ contaminated with a 40µL 2 McFarland droplet allowed viable bacteria to pass through the Q-Syte™. Alterations in the device to increase the internal pressure led to a 24 hour delay of growth; this indicates a slight reduction in viable bacteria passing through the device. Contaminated access results indicate that Q-Sytes™ contaminated with a gloved finger touch allow more bacteria to reproduce in its interior and pass through than other devices. These results are contradictory to those found in several current publications but may give better insight into the performance of these devices under real-world contamination.

Board 3

Yaser Helal

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

Based on an interest in quantum computing, the behavior of a superconducting element coupled to a micron-sized mechanical oscillator in an electric circuit was studied. The system could be treated like two blocks coupled together and on separate springs attached to walls. This coupling caused the amplitude of the first block to be decreased. Adding friction to the first block decreased the amplitude even more, whereas adding friction to the second block reduced the second block's effect on the first block.

Suppression of Quantum Fluctuations in a Josephson Junction Coupled to a Nanomechanical Resonator

The behavior of a Josephson junction (JJ) in parallel with a nanomechanical resonator was studied. Such a circuit has been proposed as the building block of a quantum computing component. It was the goal of this research to gain knowledge of the behavior of the coupled JJ-resonator system. The JJ was treated as a "particle" trapped in a quadratic potential well and coupled to the nanomechanical resonator. The problem can thus be characterized as two coupled quantum harmonic oscillators. The Feynman path integral technique was used to find the density matrix and partition function for the system, from which desired quantities could be calculated. It was found that, when coupled to the resonator, the square of the uncertainty in the position of the JJ "particle" was suppressed, i.e. quantum fluctuations of the JJ were reduced by the resonator. The uncertainty principle was obeyed by the system, in that the square of the uncertainty in the JJ's momentum was enhanced with resonator coupling. Adding damping to the system showed interesting results. Damping the junction enhanced the suppression of quantum fluctuations beyond that due to resonator coupling alone. Damping the resonator, however, suppressed the effect of JJ-resonator coupling and thus resulted in less suppression of quantum fluctuations. Preliminary results for the effects on quantum fluctuations of a weak nonlinear term in the JJ's potential energy have also been obtained.

Board 4

Steven Toaddy

Faculty Mentor: Kyle Smith
Department of Psychology

People pay more attention to negative information than positive information, but this bias can be eliminated by manipulating the mood of the individual. Certain personality characteristics predict how much attention is paid to positive and negative information, as well. The present research sought to investigate the relationship between personality, mood, and this bias to negative information. Personality did not significantly predict the size or behavior of this bias toward negative information.

The Negative Attention Bias, Affective Context and Personality

Research has demonstrated that people automatically pay more attention to negative information than to equivalently extreme positive information. However, manipulating affective context (the relative accessibility of positive and negative information in an individual's mind) can attenuate this attention bias. In addition to affective context, various personality traits (e.g., extraversion, trait anxiety, depressive tendencies, and neuroticism) also predict the amount of attention paid to positive and negative information. The present research sought to bring these two areas of research together. We investigated the hypothesis that these personality factors would predict the extent to which manipulating the affective context would change the size of the attention bias. The study involved 20 participants, with sessions held once per day for six days. To manipulate affective context, each participant was sub-optimally primed with neutral, positive, and negative words in separate sessions. Following this, an emotional Stroop task, in which participants named the colors of positive and negative trait adjectives, was used to measure attention to positive and negative information. Finally, personality information was collected using surveys. To be consistent with prior work, an attention bias to negative information should be observed in the neutral and negative but not in the positive affective contexts. Contrary to expectations, a marginally significant bias was present in the neutral context, and no bias was observed in the positive or negative contexts. Because of this lack of replication, it was impossible to evaluate the effect of personality on the attention bias. While these findings may have resulted from personality not predicting the effect of affective context on the attention bias, insufficient sample size is a potential alternate explanation. Further research in this area should address this alternate explanation, in order to more thoroughly investigate this hypothesis, by increasing sample size and decreasing the required number of sessions.

Board 5

Anisha Barbora

Faculty Mentor: Mark Schwartz
Department of Mathematics and
Computer Science

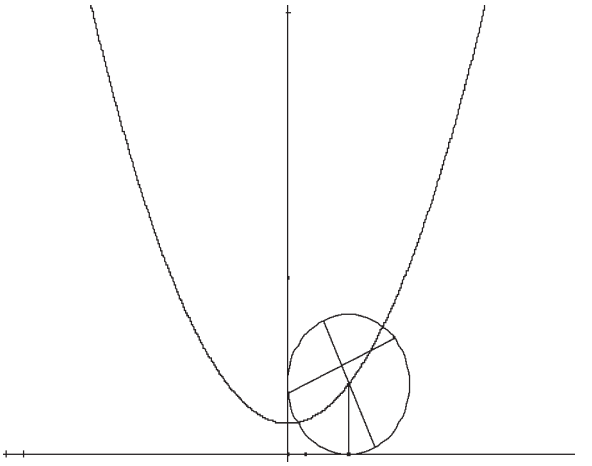
This summer we worked on optimization problems, i.e. a computational problem in which the objective is to find the maximum (or minimum) value of some function. We considered optimization problems for functions f(x, a, b) where (a, b) is a control point on which the function f is dependent. A control point is a point that can be freely moved around in the plane. Solutions were found using methods of differential geometry. This method was used to find geometric solutions because calculus procedures may be difficult or sometimes even impossible to carry out for functions that are dependent on control points. Also, when the calculus procedures can be completed they rarely yield geometric insight.

n-Parameter Optimization by Methods of Differential Geometry

Optimization problems play a major role throughout the natural and social sciences. For a differentiable function f(x) the usual optimization procedure is to use calculus. However, if the function depends on a control point (a, b), then the calculus procedure may be difficult to carry out and often lacks geometric insight. In our work this summer we considered optimization problems for functions f(x, a, b) for which methods of differential geometry could be used to find geometric solutions. These methods required background study on planar curves, including topics such as envelopes, evolutes, orthotomics, and more. The following problem is an example illustrating these ideas.

Given a point A(0, a) on the y-axis and a point B(b, c) in the xy plane, find a point P(t, 0) on the x-axis that maximizes angle APB. This is not a particularly difficult problem to solve using methods of calculus, but what is of more interest is the geometry of the problem. To develop the geometry we ask what points (b, c) will have the point (t, 0) as the optimizing point? In this problem the point (0, a) is fixed and the point (b, c) is the control point. It was found that the points (0, a) and (b, c) lie on a circle with the following equation:
$(x - t)^2 + (y - (a^2 + t^2)/(2a))^2 = ((a^2 + t^2)/(2a))^2$ for a fixed t.

As t varies, we get a family of circles, the envelope of which is the orthotomic of a parabola with the following parametric equation:
$x = t$
$y = (a^2 + t^2)/(2a)$
This parabola is, in fact, the locus of the center of the circle for varying t values. The purely geometric solution is derived from this fact. For a given point (b, c) merely construct the intersection of the perpendicular bisector of the segment AB with the parabola. The x-coordinate of this intersection is the t-value that we seek. Following is a diagrammatic representation of the solution to the above problem:



Board 6

Danielle Kapolka

Faculty Mentor: Mark Schwartz
Department of Mathematics and Computer Science

Various optimization problems involving maximization or minimization of functions were solved geometrically. Examples included finding the longest ladder that will fit around the corner of two intersecting hallways and finding the shortest distance to travel from a point to an island to another point. For optimization problems with visual solutions, some were animated using the software Geometer's Sketchpad. Among these, the most striking example involved rolling a parabola along a flat surface.

n-Parameter Optimization by Methods of Differential Geometry

Various optimization problems involving maximization or minimization of functions were solved using the methods of differential geometry aided by the software packages Mathematica and Geometer's Sketchpad. The solutions often involved the use of envelopes, a curve formed by a family of curves and which is everywhere tangent to a member of the family of curves. For example, the envelope of line segments of fixed length with endpoints lying on both the x and y axes is an astroid, which was used to find the longest ladder that will fit around the corner of two intersecting hallways, a classic calculus problem. Several general kinds of curves derived from a given curve were also used. The orthotomic, the reflection of the origin through the lines tangent to a curve, was used to find the shortest distance needed to travel from a point to a circular or elliptical island and then to another arbitrary point. Another problem was the animation of a catastrophe machine, a construction that, when animated, reaches a critical point at which sudden motion occurs. The catastrophe machine in this case is a parabolic lamina, a parabola in two dimensions, and which is controlled by the point of the center of mass of the lamina. As the center of mass is moved, the parabola will roll; its sudden catastrophic motion is linked to the evolute of the parabola, the envelope formed by the family of normal lines to a curve. The Roulette of Delaunay of the rolling parabola, the curve traced by the focus, is a parabolic catenary, the shape a free-hanging chain or cable takes. Several visual solutions to parametric curve constructions were also animated, including the Witch of Agnesi and the Cissoid of Diocles.

Board 7

Kelly E. Haines

Faculty Mentor: David Markwardt
Department of Zoology

Our project is intended to identify the molecules and mechanisms used by all cells to control when and where they "turn on" certain genes. This process, called differential gene expression, is of fundamental importance because it allows two cells with the same set of genes to make a very different set of proteins. This accounts for the stunning diversity of cell types and functions in all multi-cellular organisms. Understanding how this process is controlled is key to understanding how cells are organized into tissues, how they respond to a changing environment, and how they are able to coordinate growth during development.

Control of Gene Expression by the mRNA Surveillance Pathway

A conserved pathway called mRNA surveillance selectively degrades eukaryotic messenger RNAs containing premature translational stop signals. While mRNA surveillance acts as a cellular "watchdog" by degrading the occasional *faulty* mRNA, recent evidence from a variety of organisms suggests that certain mRNAs *always* contain a premature stop signal and are thus *always* targets of the pathway. In this case the mutation serves a mechanistic role in a regulatory process by linking the mRNA to the mRNA surveillance pathway. These mRNAs are called natural targets.

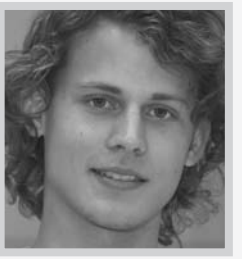
Our research goal was to identify all of the genes that code for natural targets of mRNA surveillance. To do so, we used the fission yeast *Schizosaccharomyces pombe*, a common eukaryotic model organism.

In conjunction with researchers at SUNY-Stony Brook, we probed whole-genome microarrays with transcript-derived DNA from wild-type yeast and yeast *without* a functional surveillance pathway. The microarray experiments showed that more than 100 RNAs are *more* abundant in a background where mRNA surveillance is not present, indicating that the pathway normally targets these RNAs. We decided to do additional testing on those targets with introns due to the possibility of *surveillance-linked alternative splicing*. Using reverse-transcription PCR (RT-PCR) we found four genes that show differences in the number and size of transcripts in wild-type cells compared to surveillance mutants. The identification of these alternatively spliced species will allow us to answer questions about the particular biological role played by mRNA surveillance in regulating these transcripts in response to changing environmental conditions. For example, proteins that are necessary for controlling levels of intracellular poly-amines are regulated at the level of the transcript by the mRNA surveillance pathway. We have begun experiments that will better our understanding of the mechanisms that link these and other premature stop-containing transcripts with known signal transduction pathways.

Board 8

Tov Nordbø

Faculty Mentor: Sarah Leupen
Department of Zoology



Scientists have not determined if axolotls operate similarly to mammals in regard to the negative feedback response of GnRH, though we have assumed they do. To test this we have removed the gonads of axolotls and either placed their respective hormone, estrogen or testosterone, or a cholesterol capsule in their body cavity. After several weeks we sacrificed the animals and dissected their brains. If there is a higher amount of GnRH in the cholesterol group, and the same amount of GnRH in the estrogen and testosterone group as there would be in a normal axolotl, then there is a negative feedback loop for GnRH. Otherwise it may indicate that axolotls have no negative feedback loop in regard to this particular axis or that the project was not a success and other methods are needed.

Does the Hypothalamic-Pituitary-Gonadal Axis Operate as a Negative Feedback Loop in the Axolotl?

The operation of the hypothalamic-pituitary-gonadal (HPG) negative feedback loop is well-understood in mammals: gonadotropin-releasing hormone (GnRH) stimulates the release of pituitary gonadotropins, which stimulate germ cell development and release of the gonadal sex steroids, which themselves inhibit further GnRH production and release, maintaining homeostasis. This understanding has led scientists to believe that the axis functions in a similar fashion in most other vertebrates, yet few studies have addressed this. To determine if axolotls specifically, and perhaps salamanders generally, operate the HPG axis as a negative feedback loop, we removed the gonadal tissue of 6 male and 6 female axolotls, and placed either a cholesterol, estrogen, or testosterone capsule inside the body cavity before sewing up the incision. If a negative feedback loop was functioning, then we would expect to see an increase in GnRH synthesis in the axolotls that received the cholesterol capsules due to the lack of testosterone or estrogen in the blood. After a period of two or four weeks, the axolotls were sacrificed and their heads placed in paraformaldehyde. To analyze GnRH production, the brain was cut using a Vibratome 1000 into 80µm slices. Slices were then stained using an immunohistofluoresence procedure, which allowed us to count the number of GnRH neurons in the axolotl brain and compare these numbers among the groups.

Board 9

Sara Nienaber

Faculty Mentor: Sarah Leupen
Department of Zoology

We wanted to know how a common herbicide (atrazine) causes reproductive developments in male amphibians. It was suspected that Gonadotropin-Releasing Hormone (GnRH) expression could be altered by exposure to atrazine, since this is the master hormone of reproduction. Salamanders were exposed to low levels of atrazine, estrogen, or no treatment. Animals were sacrificed at certain times during development and microscopy was used to see if their brains expressed GnRH neurons.

GnRH Expression in Atrazine-Treated Salamanders

Atrazine is a widely used herbicide that has been shown to cause demasculinization and feminization of males, immune suppression, and behavioral changes in exposed amphibians. Although atrazine's effects are well documented, the mechanism and site of action are unknown. We suspected that these abnormalities were due to the disruption of Gonadotropin-Releasing Hormone (GnRH), the master hormone of the reproductive axis. Problems in male amphibian sexual development have been seen at levels as low as 0.1 parts per billion. The legal limit of atrazine allowed in water sources is 3 parts per billion, a level approached annually in the Olentangy river in Delaware, so we chose this environmentally relevant level of exposure. Axolotls (*Ambystoma mexicanum*) were exposed to either 3ppb atrazine, 3ppb estradiol (positive control), or no chemical exposure beginning at four months of age. Animals were weighed periodically, and members of each group were sacrificed when 6 months, 8 months, and 10 months old. Immunocytochemisty was used to label the GnRH neurons in the brains of these individuals, and confocal microscopy was used to count the number of GnRH neurons present in each individual's brain.

Board 10

Katie Ayers

Faculty Mentor: Sarah Leupen
Department of Zoology

Investigating the Genetic Conflict Hypothesis in *Rattus norvegicus*

Traditionally, pregnancy is viewed as a cooperative association between a mother and her growing fetus; the mother sacrifices most of her nutritional intake to the fetus, who is commonly considered a passive member of this interaction. As the mother and fetus are genetically distinct individuals, however, they have different interests during the course of a normal pregnancy. Fetal factors increase the nutritional transfer to the fetus, while maternal genes act to limit the transfer of nutrients in excess of some optimum. A genetic conflict ensues, with the expression of maternal genes counteracting the effects of fetal genes. Hormones such as placental lactogen and placental growth hormone, released by fetal cells, are believed to alter maternal physiology, in part by decreasing maternal insulin sensitivity to provide more glucose for the fetus. The mother may counteract these measures, releasing more insulin, for example. However, if the mother is unable to compensate for this increased insulin resistance, gestational diabetes may result, a threat to maternal health.

It is our goal to investigate which hormones released by the fetal cells are involved in this conflict, as well as to model the genetic conflict hypothesis *in vivo*. To this end, we have developed (1) a method of atrial catheterization in the rat, which will allow us to take repeated blood samples in a short time from a conscious, unrestrained animal and (2) a glucose tolerance test, which we successfully performed on several animals following catheterization. These procedures will allow us to assess insulin sensitivity in pregnant rats in response to changes in fetal and exogenously delivered hormone levels. By these means, we will investigate the genetic conflict hypothesis, as well as elucidate the specific hormones involved in this interaction.

Board 11

Cory Myers

Faculty Mentor: Robert Kaye
Department of Physics and Astronomy

Atomic nuclei possess fundamental symmetries that help researchers understand their basic properties. Our project involved the measurement of an intrinsic symmetry property of a particular nuclear isotope of strontium (strontium-80) called parity. Parity is sometimes called the "mirror symmetry" since it describes whether or not the spatial distribution of a nucleus would look the same or inverted if it were reflected in a mirror. Determining the parity of strontium-80 when it possesses certain discrete energies can help us infer important fundamental properties, such as how individual protons and neutrons are distributed and the relative energy they possess. Our measurements deduced the parity of strontium-80 at several discrete energies and showed that it is more similar to its neighboring nuclei in this regard than was thought in earlier studies.

Parity Measurements in the Strontium-80 Nucleus

There are fundamental gaps that exist in our knowledge of the ^{80}Sr nucleus, despite nearly 20 years of extensive experimental and theoretical investigation. In particular, the parity (or reflection symmetry) of many of its excited energy states remain only estimates based on the systematics developed by neighboring nuclei. Until recently, ^{80}Sr was thought to possess only positive-parity states, in contrast to many other neighboring nuclei which are known to have a majority of negative-parity states. Now there is indirect experimental evidence for negative-parity states, but the parities have not been measured directly. The goal of this study was to finally resolve this long-standing mystery by measuring conclusively the parities of as many excited states in ^{80}Sr as possible. ^{80}Sr nuclei were produced at Florida State University from a fusion reaction between a beam of ^{28}Si ions accelerated to a kinetic energy of 90 MeV and a target of ^{54}Fe atoms. Following the reaction, many excited states in ^{80}Sr were populated and data were collected on the resulting cascades of emitted γ rays using a high-resolution array of 10 Ge detectors. The linear polarizations of 30 γ rays were measured and many times allowed for the determination of the parity of the parent state that released the γ ray. The results have conclusively verified negative parity for one sequence of states, and have verified the previous assignment of positive parity for two other sequences. A fourth sequence of states has been tentatively assigned negative parity.

Board 12

Rachel Weintraub
Caitlin Chesnut

Faculty Mentor: Katherine Hervert
Department of Chemistry

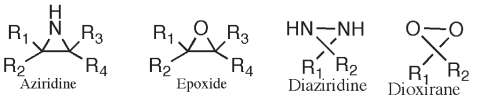
Functional groups are groups of atoms that are bonded to each other in a certain way. Each different functional group reacts in a certain way with other functional groups, and the synthesis of pharmaceuticals is dependent upon this principle, as they contain functional groups that react with those present in the body. Our work focused on trying to find a new, universal way to make a functional group called an aziridine, which can currently only be synthesized under harsh reaction conditions. There is a functional group that is very similar to the aziridine, with only one atom being different, so we are attempting to model our synthesis after the synthesis of that compound, while employing different reaction conditions and using slightly different chemicals.

Functionalized Diaziridines as Potential Electrophilic Aziridinating Agents

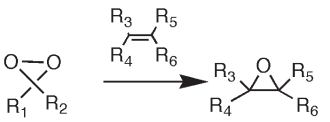
Functional groups are groups of atoms that are bonded to each other in a certain way. Each different functional group reacts in a certain way with other functional groups, and the synthesis of pharmaceuticals is dependent upon this principle of organic chemistry. Our work focused on trying to find a new, universal way to make a functional group called an aziridine, which can currently only be synthesized under harsh reaction conditions (figure 1). Our methodology is modeled after a similar system that has achieved great success (scheme 1). By simply changing one or two atoms, we should be able to mimic the existing model using our compounds to make the aziridine (scheme 2).

The majority of research focused on the synthesis of diaziridines with different substituents. Attempts to synthesize 3-(4-methoxyphenyl)-3-trifluoromethyldiaziridine and 3-(4-nitrophenyl)-3-trifluoromethyldiaziridine were largely unsuccessful; however, 3-(4-methylphenyl)-3-trifluoromethyldiaziridine was successfully synthesized (scheme 3). Product identities were determined via analyses of 1H NMR spectra after each step of the synthesis. Various attempts were made to react the diaziridine with the alkene functional group. Reaction conditions were varied, but only one alkene reagent was used, stilbene. Future research will focus on continued attempts to synthesize diaziridines with different functional groups, including further attempts to synthesize 3-(4-methoxyphenyl)-3-trifluoromethyldiaziridine. No further attempts will be made to synthesize 3-(4-nitrophenyl)-3-trifluoromethyldiaziridine, as the electronics of the reaction prevent the synthesis from being successful. Further experimentation will be done using different alkenes and reaction conditions.

Figure 1: The Aziridine and its Oxygen Analog

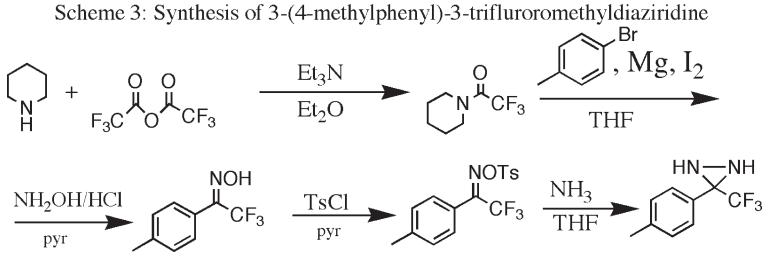


Scheme 1: Epoxide Synthesis using Dioxirane



Scheme 2: Aziridine Synthesis using Diaziridine

Scheme 3: Synthesis of 3-(4-methylphenyl)-3-trifluroromethyldiaziridine



Board 13

Nalin Vutisalchavakul

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

Imaging Starspots on II Pegasi via Light-curve Inversion

Starspots on the star II Pegasi were mapped via the method of Light-curve Inversion. Starspots are areas on the surface of a star which are cooler and thus darker than their surroundings. As dark starspots are carried into and out of view of Earth by the star's rotation, they lead to variations in the star's observed brightness. Light-curve Inversion is a mathematical technique which infers the appearance of the spots based on these variations. Starspots are magnetic phenomena similar to sunspots on the Sun, so that studying starspots on other types of stars besides the Sun should lead to a more general understanding of stellar magnetic phenomena. We analyzed two data sets. The first set was obtained with the 0.4-meter Vanderbilt/Tennessee State University Automated Photometric Telescope from September 1995 to January 1996 (Greg Henry, private communication). The result of the analysis is that the star had two starspots on its surface, and that the locations of the two starspots change relative to one another. The spot with higher latitude appears to have a shorter rotation period about the star's rotation axis than the spot closer to the equator. This result implies that II Pegasi has opposite differential rotation to the Sun's, on which spots at higher latitudes have longer rotation periods. The second data set we analyzed was also was obtained via the same telescope between November 1988 and September 1982 (Henry, et al. 1995, ApJSS, 97, 513). We analyzed these data to track changes of the starspots over a long time interval and to see if we could confirm the intriguing result regarding the star's differential rotation obtained from the other data set. The resulting surface maps show much interesting activity. Several starspots were observed throughout the interval with usually two spots visible at the same time. There appears to be new spots forming while others disappear. There is strong evidence of differential rotation, but no definite conclusion can be drawn about whether the differential rotation is the same or opposite that of the sun due to the difficulty of reliably determining the latitude of individual spots. This difficulty arises in part because the data were obtained through only two photometric filters (B and V). Future observations of the star through a larger set of filters might resolve this ambiguity.

Board 14

Amy Gearica
Sahar Mazhar
Britta Buchenroth

Faculty Mentor: Danielle Hamill
Department of Zoology

C. elegans is a model organism for studying cell division and development. Cell division is an important and conserved process that must be highly regulated. We have a mutant *C. elegans* strain that fails to undergo proper cell division. The main goal of our project is to identify the gene that is mutated in this organism.

Molecular Mapping of a Cell Division Mutant in *C. elegans*

Early embryonic development in *Caenorhabditis elegans* is a process defined by a series of highly regulated cell divisions. A spindle defective mutation (*spd*) is a temperature sensitive, early embryonic lethal mutation. At a restrictive temperature, this mutation results in the failure of mitotic spindle assembly and the presence of a multi-nucleated embryo, which will die. Prior to this summer it was determined that this mutation is on chromosome III. To narrow down the location of the *spd* mutation, a deficiency cross and SNP-Snip mapping procedures were used. The results of the deficiency cross were inconclusive due to the adverse effects on the deficiency strain when placed at the restrictive temperature. SNP-Snip mapping is a variation of 3-point mapping that involves isolating DNA from meiotic recombinants and analyzing the restriction digest patterns. Based on the molecular data collected the *spd* mutation appears to be to the left of 2.1 map units. With the goal of identifying the gene that is defective in *spd* mutants, transformation rescue will be done. Toward this end, DNA in the form of cosmids and YACs were prepared for future injections and rescue. Because cell division is a highly conserved process, what we learn from studying cell division in *C. elegans* may help us to better understand cell division in other organisms including humans.

Board 15

Britta Buchenroth
Sahar Mazhar
Amy Gearica

Faculty Mentors: Danielle Hamill and Ramon Carreno, Department of Zoology

We are characterizing a new species of nematode found on a millipede at the Kraus Preserve. Comparisons were made between the model organism, *C. elegans*, and this new nematode. We report some similarities and some intriguing differences between the two species, which we will continue to investigate.

Characterizing a new *Rhabditis (Oscheius) sp.*

A new nematode species was isolated from a millipede, *Euryurus leachii*, from the Kraus Preserve in Delaware, Ohio. We are able to culture the worm using standard *C. elegans* reagents and techniques. Using morphological characteristics and DNA sequencing this new nematode species was identified as *Rhabditis (Oscheius) sp.* The hermaphrodite adult *Rhabditis sp.* is approximately 1.4 times larger in length than the wild type *Caenorhabditis elegans*. The embryos are also slightly larger than those of *C. elegans*. We are particularly interested in the polarity of this nematode in early embryonic development, so we measured morphological characteristics such as the location of pronuclear fusion, mitotic spindle formation, and cleavage furrow position via DIC and immunofluorescence microscopy. Through the observations of early embryonic development, the embryo demonstrates a significant amount of membrane ruffling prior to pronuclear fusion as well as blebbing between cell divisions. The cell cycle timing of the nematode was also observed and compared to the wild type *C. elegans*. Interesting comparisons between *C. elegans* and other nematodes, including *Rhabditis (Oscheius) sp*. have been described, particularly with respect to later development. We believe additional interesting findings will be unveiled by comparative studies of early embryonic cleavages and development.

Board 16

Steve Yang

Faculty Mentor: Heather Grunkemeyer Department of Chemistry

So far the study of the binding of Ritalin onto Dopamine Receptors has only been conducted using radio labeling. We hope to formulate a new and more efficient way of studying this process by the use of fluorescence.

Study of Ritalin Binding to Dopamine Receptors Using Fluorescence

The Dopamine Transporter (DAT) serves a wide range of functions and plays a key role in the human body. The DAT can bind to a variety of agonists and antagonists; one such ligand is Ritalin, a drug used around the world to treat Attention Deficit Disorder. Thus far, radio labeling has been the main method used in studying the binding of Ritalin to the DAT. We have investigated a new method based on fluorescence for studying the binding of Ritalin to the DAT. A fluorescent Ritalin derivative incorporating naphthalene was synthesized. The fluorescent properties such a emission spectra, quantum yields, and fluorescent lifetimes of naphthalene, a naphthalene precursor and the naphthalene Ritalin derivative were investigated in a variety of solvents ranging from nonpolar to polar. All three systems showed environmentally sensitive fluorescence indicating they should be strong candidate for studying binding by fluorescence. ß- Cyclodextrin was then used to mimic the binding environment. The quantum yield, emission spectra, and fluorescent lifetime of the three compounds bound to ß- Cyclodextrin were measured. Changes in all three properties of the compounds from the free to the bound environment indicate that fluorescence may be a viable method for studying the binding of Ritalin to the dopamine Transporter.

Board 17

Lauren Woods
Patricia Troy

Faculty Mentor: Amy Downing
Department of Zoology

Creating Communities: the natural assembly of experimental ponds

Mesocosms, medium sized replicas of larger ecosystems, are commonly used in ecological research as a way to conduct controlled and replicated experiments at smaller scales than entire ecosystems. Traditionally, the communities within these mesocosms are deliberately assembled by the scientist to meet the needs of a particular experiment. However, these assembled communities have been criticized as being artificial, and therefore not directly applicable to the natural environments they seek to replicate. The purpose of this experiment was to create experimental pond communities with properties more similar to ponds found in nature. thirty-six Mesocosms (300 liter cattle watering tanks) were filled with pond water and left for nine months near two separate source ponds located in the OWU Kraus Nature preserve. Over the nine months, species from the natural ponds were allowed to colonize the mesocosms through natural dispersal mechanisms. Variables such as nutrients, productivity, phytoplankton, zooplankton, and the macroinvertebrates were used to determine the similarity of mesocosms to one another and to their source pond. We found that the mesocosms are similar to each other, but differ from their source pond in terms of species composition and diversity. The discrepancy between pond and mesocosm communities may be due to the length of time the mesocosms were allowed to assemble, and the variable dispersal abilities of the species living in the natural ponds. Thus, the self-assembly method used here can successfully create replicate ecosystems that can be used in future experiments, but does not create ecosystems that replicate the properties of nearby natural ponds.

Board 18

Sam Valerius

Faculty Mentor: Ramon Carreno
Department of Zoology

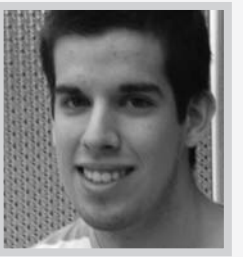
In 1986 the Ohio Division of Wildlife began a seven-year program to reintroduce the North American river otter, *Lontra canadensis*, back into Ohio since its extirpation in the 1800s. River otters have now been reported in over 50 of Ohio's 88 counties, but no data exists on the parasites that have infected the river otter in Ohio and little data exists overall on river otter parasites in North America. In this study the GI tracts, hearts, lungs, and sinus cavities were all examined for parasites through necropsies of river otters trapped in Ohio in 2005.

Parasite Survey of the Reintroduced River Otter, *Lontra canadensis*, in Ohio

The first records of parasitic infections in the reintroduced North American river otter, *Lontra canadensis*, from Ohio are reported. The river otter was extirpated in the 1800s from Ohio and recent reintroduction programs by the Ohio Division of Wildlife have led to otters repopulating two-thirds of Ohio in less than 20 years. Data on parasites of the river otter is scarce throughout North America and no data has ever been recorded from river otters in Ohio. In the present survey, necropsies were done on the GI tracts, lungs, hearts, and skulls from river otters obtained from the 2005 trapping season and examined for parasites. Three species of trematodes and two species of acanthocephalans were recorded from the GI tracts of river otters. The most common parasite found was the trematode *Baschkirovitrema incrassatum* with a prevalence of 40%. A noticeable difference was found in the prevalence of *B. incrassatum* between counties with only four of the 16 counties surveyed reporting infection of *B. Incrassatum* at 50% orhigher, while the other 12 counties surveyed had no infections of *B. incrassatum*. The four counties with infected otters geographically coincide with two of the four original watersheds that the otters were released in, suggesting that the otters were reintroduced in Ohio with these parasites. A considerable difference was found between infection of male and female otters with prevalence of *B. incrassatum* at 31% and 47% respectfully. No parasite infections were found in the lungs, sinus cavities, or hearts of the river otters. The data recorded provides the first parasite prevalence baseline for river otters in Ohio that can be monitored in future trapping seasons.

Board 19

Max Schroeder



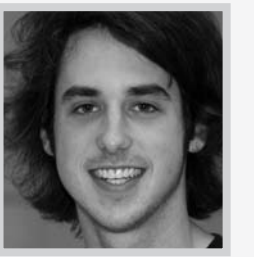
Faculty Mentors: Edward H. Burtt, Jr., Laura Tuhela-Reuning, Departments of Zoology and Botany/Microbiology

Quantifying the concentration of oligopeptides released from feathers during *in vitro* degradation by *Bacillus licheniformis*

Keratinase produced by feather-degrading bacilli breaks the b-keratin of feathers into oligopeptides. As bacterial degradation of the feathers progresses, oligopeptides accumulate in the medium. To quantify the rate at which a microbe degrades feathers, the concentration of accumulated oligopeptides can be measured spectrophotometrically. Previously, oligopeptide concentrations were measured by obtaining the absorbance at 230 nm (Goldstein *et al.* 2004). While effective, the 230 nm method of protein determination requires taking a single measurement for each sample. We used a commercially available bicinchoninic acid (BCA) protein assay kit that uses colorimetry to detect proteins and determined if the BCA method was comparable to the 230 nm method. The BCA method allows up to 96 samples to be analyzed at once using a microtiter plate. We used both methods to analyze oligopeptide concentrations in uninoculated control flasks of feather medium and flasks of feather medium inoculated with *Bacillus licheniformis*. All flasks were incubated for five days at 37°C. The two methods produced comparable results; on day five the BCA and 230 nm methods were used to determine that the average protein concentration of the inoculated samples was 125 ± 20 µg/mL and 122 ± 18 µg/mL, respectively. This suggests that *in vitro* feather-degradation can be quantitatively assessed by either method. Furthermore, both methods showed some oligopeptides in solution following autoclave sterilization, but a significant increase in concentration only when feather-degrading bacilli were present.

Board 20

Jack M. Stenger



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

Pattern of damage among tail feathers of sparrow

Typically, songbird tail feathers are dark or the central tail feathers are dark and the lateral tail feathers have small to large amounts of white on the medial surface of the vane. We hypothesize that the light colors in the tail occur where damage is minimal, because melanin in dark feathers strengthens them. The tail feathers are subjected to three types of damage: abrasion by airborne particles, bacterial degradation, and collision with objects. The relative importance of these three factors in damaging the tail feathers is uncertain. We quantified the damage in the tails of museum specimens and wild birds caught in mist nets. We also compared damage to the tail of related species of sparrows in different habitats. Understanding the pattern of wear among tail feathers may help us identify the source of the damage and better understand the potential cost of different color patterns in the tails of songbirds.

Board 21

Jeffrey M. Harrison

Faculty Mentor: Laurel J. Anderson
Department of Botany/Microbiology

The growth of garlic mustard is a risk to native plants in a forested environment as it may grow as dense patches across a small area. Garlic mustard has been observed to grow at the base of large trees in sites near Delaware, Ohio. This study was done to see how garlic mustard plants grow in relation to trees within a forested site. Results show that these plants grow near trees but further work is needed to tests why garlic mustard is growing in this manner.

Spatial association of the invasive *Alliaria petiolata* to large trees

Alliaria petiolata (garlic mustard) is an established invader of temperate forests in Central Ohio. It is a shade-tolerant, biennial that overwinters as basal rosettes and by early spring it grows a flowering stalk. Invasive plants have been identified as one of the major threats to ecosystem function and biodiversity. Little is known about the invasion patterns of *A. petiolata* in the habitats that it invades. It has been observed, but never quantified, that *A. petiolata* has a close association with the base of trees. This study examined the distribution of *A. petiolata* populations in comparison with large trees in a natural habitat of Ohio Wesleyan's Kraus Preserve near Delaware, Ohio. The goal of the population study was to determine if *A. petiolata* plants are randomly distributed throughout the forest floor or if there exist groups of them that have common distributional patterns related to large trees. A 40x50 meter plot was set up using tape measures as "X" and "Y" axes on a site that contained *A. petiolata* plants. Each tree with a Dbh of 5 cm or larger was given an X/Y coordinate value. *A. petiolata* plants were either grouped as a patch if there were two plants within half a meter of each other or as single plants, and each was given coordinate values. The recorded X/Y values were entered into Microsoft Excel and the plot was mapped out as a graph. Spatial analysis was preformed on each coordinate point using the statistical software package "R". Evidence suggests that there is a relationship between *A. petiolata* and large trees based on the coordinate data collected. Why these plants grow near the base of trees needs further investigating to determine possible contributing factors. Trees may provide a key microhabitat for the initial invasion of *A. petiolata* into new sites.

Board 22

Scott Williams

Faculty Mentor: Laurel J. Anderson
Department of Botany/Microbiology

Alliaria petiolata, (a.k.a. garlic mustard) is an invasive, or non-native, plant species present in both the Kraus and Bohannan Preserves. Like other invasive species, garlic mustard is free of the limiting constraints from its home range and can proliferate freely, affecting the biodiversity of its new habitat. Our study aimed to determine if garlic mustard was spreading within these preserves and how it was influencing their biodiversity. We concluded that garlic mustard was influencing the biodiversity of plots where it existed and was moving toward a strategy of higher-yield individuals to increase its presence in the preserves.

The Ecology of Invasive Garlic Mustard (Alliaria petiolata) in the Ohio Wesleyan Kraus and Bohannan Preserves

The Kraus and Bohannan wildlife preserves are mesic, forest communities that can be compared in order to understand the effects of invasive species on forest biodiversity. *Alliaria petiolata* (garlic mustard) is an invasive, herbaceous plant species present in both the Kraus and Bohannan preserves near Delaware, Ohio. *Alliaria petiolata* comes in direct competition with native plants species for resources such as light, space, and soil nutrients, which could ultimately influence both preserves' biodiversity. In an ongoing study, we sought to test whether *Alliaria petiolata* was increasing in population size and if it has a significant impact on the biodiversity of the Kraus and Bohannan preserves. We established, fifty-meter by two-meter transects throughout both preserves, with a target number of eight, 2x2 meter plots set up at five-meter intervals along each transect. In each plot, ground cover and plant stem count data was recorded in a 1x1 meter square area for all plants present. A count of the total number of *Alliaria petiolata* rosettes present within the 2x2 meter plot was also recorded, as well as an estimate of the number of siliques per plot. While populations of *Alliaria petiolata* rosettes in both preserves significantly changed from one year of study to the next, there was no conclusive trend in these changes to suggest growth in one direction or the other. Seed rain in the Kraus preserve was found to be significantly greater in 2007 than in 2005 with plant communities coexisting with *Alliaria petiolata* being found to be significantly different in their species composition compared to those in which *Alliaria petiolata* was absent. The differences in community composition and the increase in seed rain suggest that the invasive plant has an influence on the community dynamics of each preserve and is pushing to increase its population size.

Board 23

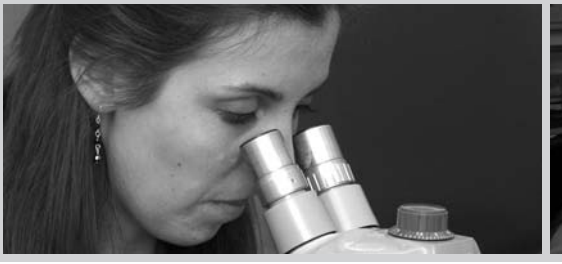
Jacqui Barker
Sara Koenig

Faculty Mentors: Harry Bahrick, Lynda Hall, Mindy Baker
Department of Psychology

As we get older, recalling information we know, such as a person's name or foreign language vocabulary learned in school, can become more difficult. We can recognize the answer when we see it, but we are unable to always come up with the answer "off the top of our head." The goal of this project is to quantify age-related deficits in recalling versus recognizing the same information, to relate the deficits to education, speed of processing, and short term memory, and to compare methods of restoring recall. We compared recall and recognition of Spanish vocabulary learned in school for individuals of three age groups, and related the deficits in recall to a number of variables.

The Effect of Aging on Memory of Spanish Vocabulary

Older adults have problems recalling information, even though their ability to identify the same information on tests of recognition remains relatively unimpaired (Whiting & Smith, 1997). The goals of this project were to a) quantify the differential decline on a Spanish vocabulary test of recall and recognition, b) relate the amount of decline to other variables, e.g., educational level, measures of immediate memory and learning, and c) evaluate the effectiveness of interventions designed to restore recall. Ninety-three young (18-25), 99 middle-aged (40-55), and 84 older adults (70-85), who had taken Spanish courses in high school or college, took a computerized test of Spanish vocabulary. The words were selected from beginning Spanish textbooks. Half of 240 questions were presented in recall format, the other half in multiple-choice recognition format. The difficulty of words assigned to the two test formats was equated on the basis of prior data. For recall items, a participant was presented with the English word and asked to type the corresponding Spanish word. For incorrect responses, 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 the recall items after an interval of 30 minutes, one day, seven days, or 30 days. For recognition items, a participant we presented with the English word and asked to select the correct Spanish word from a list of four choices. Recall-recognition deficits and recall recoveries will be quantitatively related to age, education, processing speed, and other individual difference variables.



Board 24

Amanda L. Matthews

Faculty Mentor: David H. Hall
Department of Neuroscience, Center for *C. elegans* Anatomy, Albert Einstein College of Medicine

Neuron receptors are carried back and forth from the synaptic membrane of the neuron to internal cellular compartments to control the intensity of a signal response. Two proteins involved in the endocytosis, or movement from the synaptic membrane to an internal compartment, of the AMPA receptor have been identified in *C. elegans* (LIN-10 and RAB-10). Initial work has indicated that LIN-10 and RAB-10 function in two separate and distinct pathways. To confirm these interpretations, antibody staining and TEM are being used to visualize the location of the AMPA receptor in neurons in both *lin*-10 and *rab*-10 mutants.

AMPA Receptor Trafficking in *C. elegans* Using EM-Immunohistochemistry

AMPA-type glutamate receptors (AMPARs) are removed from the membrane surface of neurons through a regulated version of endocytosis. The amount of receptors on the membrane, and their transport between the synaptic membrane and endosomal compartments, is critical for synaptic plasticity. Here, AMPAR trafficking is studied using a GFP-labeled GluR-1 subunit in *C. elegans* motor circuits, which regulate locomotion. GluR-1 has previously been shown to be transported from the synaptic membrane to the endosome by LIN-10 (Glodowski *et al.*, 2005). Initial work has identified the GTPase RAB-10 as a novel trafficking protein for GluR-1 endocytosis distinct from the LIN-10 pathway. lin-10 mutants only are suppressed by *unc*-11 and *itsn*-1 mutant strains, indicating a role for clathrin-mediated endocytosis. However, *rab*-10 mutants are suppressed by cholesterol depletion, demonstrating that its endocytic pathway in neurites utilizes lipid rafts instead. To confirm these interpretations, high pressure freezing, and EM-immunohistochemistry are being used to visualize the location of GluR-1 in neurons in both *lin*-10 and *rab*-10 mutants.

Board 25

Erin N. Hoagland

Faculty Mentor: Kevin A. Roth
Department of Neuropathology, University of Alabama at Birmingham

Chloroquine is a drug known to inhibit a necessary process in cells called autophagy. When autophagy is inhibited, vesicles called autophagic vacuoles accumulate and the cell becomes stressed. If this stress is not alleviated different types of cell death can occur. Accumulation of autophagic vacuoles have been identified in a variety of neurological disorders. Due to possible medical implications, we looked at the effect of chloroquine in a region of the cerebellum.

The effects of chloroquine on neural precursor cells in the external granule cell layer in P8 mice

Neural precursor cells play an important role in normal brain development. Dysregulated death of neural precursor cells may contribute to a variety neuropathological conditions including various types of cognitive dysfunction, formation of brain tumors, and neurodegeneration. Numerous neurological diseases are linked to neuronal cell death, and their potential treatments are dependent on the understanding of the initiation of cell death and the overall mechanism of the various death pathways. The process of a tophagy is becoming a widely recognized component of these death pathways.

Autophagy is a constitutively active process that provides nutrients to cells by degrading unnecessary proteins and organelles. Macroautophagy is a specific type of autophagy in which an autophagosome transports proteins and organelles to the lysosome for destruction. When the normal level of autophagy is altered in the cell, either by nutrient deprivation or lysosomal dysfunction (induced with chloroquine), autophagic stress occurs. If autophagic stress is not corrected, caspase-dependent and -independent cell death can occur. Autophagic stress and accumulation of autophagosomes have been shown to be present in a variety of neurodegenerative diseases.

We hypothesized that administration of chloroquine, a lysosomotropic agent, would cause autophagic stress and cell death in the external granule cell layer of P8 mice. In order to test this hypothesis, P8 mice were injected with chloroquine. After six hours, the mice were sacrificed and brains were processed for histological and biochemical analysis. It was found that a 100mg/kg dose of chloroquine induced a notable increase in activated caspase-3 and levels of LC-3 in the cerebellum. Apoptotic-like nuclei were also evident at this dose. Therefore, we concluded that chloroquine, in a dose-dependent manner, induces apoptosis and autophagic stress in the external granule cell layer.

Board 26

Rachael Roettenbacher

Faculty Mentor: A. Peet Hickman
Department of Physics, Lehigh University, Bethlehem, Pennsylvania

When the nuclei of the atoms of the molecule NaK are separated a series of different energy levels occur. These energy levels were previously measured and a function, a potential curve, was adjusted to fit these values. The function in this research did a better job of fitting the data than a previous study by resulting in a potential function that is more physically realistic.

Analysis of the $1^3\Delta$ Potential Curve of NaK

The process of determining energy levels from a given potential is relatively straightforward; however, the inverse process, given certain energy levels how to determine the potential is more difficult. In this study, a potential curve of the $1^3\Delta$ state of NaK was created based on experimentally determined energy levels. A previous analysis of these data yielded a potential curve that had some unphysical wiggles at high internuclear separations. The goal in this research was to suppress these wiggles by using a different method that would better determine the physical shape of the potential of the $1^3\Delta$ state of NaK. The potential fitting program *DPotFit 1.1* by Robert J. Le Roy was used with a modified expanded Morse oscillator (EMO) potential. The EMO potential was used because of its flexible analytic form for single well potentials. The modification made to the EMO potential was that a dispersion term, $V_{dispersion}$, was added to account for the behavior of the well at high internuclear separations. The modified EMO potential did not eliminate the wiggles, but it did reduce them. The rms deviation between the calculated and experimental energy levels was 0.021 cm^{-1} for the new fit, compared to 0.026 cm^{-1} for the previous fit. The use of parameters in fitting energy levels is essential; here, the number of fitting parameters was reduced from the previous study. The employment of the modified EMO potential allowed for a better fit to the experimental energy levels and a more realistic potential function for the $1^3\Delta$ state of NaK.

Board 27

Jacqui Barker

Faculty Mentor: Randy Nelson
Department of Psychology, The Ohio State University

This project aims to evaluate how immune function is altered by disruption of normal circadian rhythms caused by exposure to constant light. Twenty-eight male mice will be housed in constant light or in 14h:10h light dark conditions for three weeks, sufficient to cause circadian disturbance. At this time, immune function will be assessed by inducing delayed-type hypersensitivity response.

Constant Light Effects on Skin Immune Function

Circadian rhythms are endogenous rhythms that control behavior, physiology, and metabolism across an approximately 24 h cycle. External stimuli, especially light, can maintain a constant circadian rhythm. The phase of circadian rhythm can be adjusted by altering the daily light-dark cycle.

Photic entraining stimuli are delivered via retinal ganglion cells to the suprachiasmatic nuclei (SCN), which in turn modulates melatonin synthesis. Since the inception of artificial light, photic input is no longer rhythmic. In the U.S. and Europe, 99% of the population never experiences true night darkness, which can result in significant suppression of melatonin levels.

Disruption of the circadian rhythm has been shown to have profound effects on physiology and behavior. Changes in melatonin release can alter hormone rhythmicity, metabolism, and immune function. Such changes lead to increased risk of multiple health problems, including obesity and several types of cancer.

Research has demonstrated that T lymphocyte rhythms are maintained in constant light environments despite suppression of temperature and activity cycling (Depres-Brummer, et al. 1997). However, the functional effect of constant light on immune function has not been determined. Delayed-type hypersensitivity responses occur when antigen-presenting cells in the skin activate memory T cells, which then release inflammatory mediators. Mediators recruit effector cells, especially monocytes, macrophages, and NK cells (Dhabhar & McEwen, 1997) that produce inflammation.

Fourteen male Swiss-Webster mice were housed in constant light conditions. Seven were given a light escape option, while the others were provided a novel object that allowed exposure to light. Fourteen additional mice were housed in 14h light, 10h dark conditions, with half receiving light escape option and half receiving a novel object. After three weeks, DTH will be induced by application of antigen to pinnae. Response can be quantified by measuring inflammation at pinnae.

Board 28

Stephanie Vasicek

Faculty Mentor: Edwin Wintucky
NASA Glenn Research Center

The effects that a Traveling Wave Tube (TWT) amplifier has on two different signals passing through it were studied. Pulses were compared using a couple of different software programs to get data. Comparisons were made at several different locations along a circuit: input, output, and the signal directly.

Next Generation High Power Dual-Frequency Transmitter For Space Borne and/or Air Borne Doppler Radar Precipitation Measurements

Data analysis was performed using a Tektronix RSA 3303A Real-Time Spectrum Analyzer with the objective of demonstrating that an approach using Ka-band Differential Frequency Precipitation Radar (DFPR) works when operating a single Boeing Traveling Wave Tube (TWT) Model 999H to amplify two pulses. This approach is being studied to replace a current model using two separate TWTs at two separate frequencies. Applicability of MATLAB, Tektronix, and Agilent software was explored. Using this software, pulse analysis techniques were further investigated and refined. Vector Signal Analysis software used with an Agilent Performance Spectrum Analyzer observed modulated signals at Ka-band in the time domain and is being further investigated to enable more detailed quantitative comparisons. MATLAB Signal Processing Toolbox is being explored as a possible analysis tool. A staggered pulse method of study was determined to be more advantageous than a simultaneous pulse study in that full peak power at each frequency can be viewed and intermodulation products can be avoided. Current work includes refining ability to evaluate radar pulse modulations, investigating new filtering techniques to minimize intermodulation products, investigate distortion effects, and phase modulation due to TWT, comparing NASA Glenn Research Center findings to NASA Goddard Space Flight Center calculations, and improving ways to quantitatively measure pulse characteristics after passing through TWT.

Board 29

Asegedech Shimellis

Faculty Mentor: Dr. Wheatlyl
Department of Biological Sciences

Crayfish of the species *Procambarus Clarkii* were placed in two different conditions: saltwater and freshwater. After two weeks the crayfish's tail tissue was removed. Western Blots were then used to compare the levels of three Calcium transporting proteins called SERCA, PMCA, and NCX, between the fish that had been placed in the saltwater condition and the freshwater condition.

The Effect of Salinity on Calcium Ion Transport Proteins in Crayfish Axial Abdominal Muscle

Crayfish and other molting crustaceans are ideal model organisms for the study of Ca2+ uptake mechanisms. The exoskeleton of the crayfish is a rigid layer of hardened calcium carbonate, which needs to be periodically shed and re-calcified to allow the crayfish to grow. During this molting cycle, there are significant changes in the uptake and localization of Ca2+ in the body of the crayfish. These fluctuations in Ca2+ levels make the crayfish appropriate animal models for the study of calcium uptake mechanisms. Intermolt is the stage in the molting cycle during which there is a balance in the amounts of Ca2+ being taken up and excreted. In this study, intermolt axial abdominal muscle tissues were used. Previously, specific proteins have been identified, which play major roles in the homeostasis of Ca2+ in crayfish. Among these are: SERCA- Sarco/Endoplasmic Reticulum Ca2+ ATPase, PMCA- Plasma membrane Calcium ATPase, and NCX- Na+/Ca2+ Exchanger. In this study, crayfish, *Procambarus Clarkii* were acclimated to a high salinity environment as well as a freshwater control condition. Western Blots were performed to observe and compare the expression of SERCA, PMCA and NCX in the axial abdominal muscle between these two conditions. All three proteins were expressed at higher levels in the saltwater tissues as compared to the freshwater ones.

Board 30

Jeffrey Thongsawath

Faculty Mentors: David M. Katz and Michelle Nebergall
Department of Neurosciences and Master of Public Health,
Case Western Reserve University School of Medicine

This research involved creating and defending a public policy proposal on a current topic in biomedicine and public health. Female Genital Cutting was chosen as the public health issue, and was researched thoroughly through a mixture of library research and mentoring by a public health expert. A two-part policy (Three-A Plan and medicalization) was created. The policy expanded on the existing efforts by various government and health organizations.

Elimination and Harm Reduction of Female Genital Cutting in Northeastern Africa

Female Genital Cutting, or FGC, is a harmful practice that has been performed for centuries and is still present today. The practice is deeply rooted in tradition among many communities and is performed by villagers using no anesthesia and non-sterile instruments. It is performed for psychosexual, historical, and various other reasons. Parents usually have their daughters cut between the ages of five and 14. Severe negative health consequences of FGC are a result of the practitioners' lack of skill, or the females' inaccessibility of appropriate medical care. Short and long-term health consequences include, but are not limited to: severe shock and pain, urine retention, injury to adjacent tissues, immediate fatal hemorrhaging, extensive damage of the external reproductive system, complications in pregnancy and childbirth, vesico vaginal fistula, and HIV.

Our library-based research involved developing and defending a public policy proposal on FGC. It was found necessary and practical to incorporate a temporary, transitional solution based on a harm-reduction strategy, while expanding on the existing efforts put forth by numerous governments, and health and human rights organizations, such as the WHO and UNICEF.

We devised a two-part policy to combat FGC. Part I, the Three-A Plan, involves *Awareness*- to inform and educate, *Advocacy*- to promote gender equality, and *Action*- the implementation of various programs. Part II of the policy is Medicalization. It involves defining FGC as a social problem, then adopting a medical framework, and finally, devising a medical intervention strategy by providing proper facilities and training. Our policy focuses on Northeastern Africa because of the high incidences of FGC, and it emphasizes the need to combine awareness and medicalization strategies to have a realistic and effective approach to improve women's health and reduce the incidence of FGC in Northeastern Africa.



Dr. Lawrence E. Young ’35 Awards Project »

Established in 1994, this award is presented to students interested in health-related careers.

Board 31

Danny Peters

Faculty Mentors: Herbert DuPont, Charles Ericcson, Norma Hernandez, and Dorothy Ruelas University of Texas Health Science Center: Guadalajara, Mexico.

Guadalajara, Mexico: Antibiotic Treatment of Traveller’s Diarrhea

During the past summer of 2007, I took part in a regular senior student elective for Baylor College of Medicine and University of Texas medical students. For the past 30 years this elective has been organized to answer a number of important public health questions of acute diarrhea with a focus on traveller’s diarrhea. With a team of nine other students and the help of several infectious disease physicians, two studies consisting of laboratorial and clinical work were held in Guadalajara, Mexico: the first “wellness study” was generated to identify the genetic influences of traveller’s diarrhea susceptibility; the second “illness study” was a fluoroquinolone (Prulifloxacin) double-blind placebo controlled stage-3 study for FDA approval.

Each day from 8-2p.m. (M-F) specimens were collected and case report forms were filled out at several clinic sites around the city. During the off-hours completeness and accuracy of the collected data were monitored. Infectious Disease seminars were also given two hours a day by the directors Dr. Herbert DuPont and Dr. Charles Ericcson. Participants in the studies were observed several times a week and were called by phone or notified by e-mail if regularly absent from the clinic. Therapy was provided in the form of antibiotics and medical advice. They were warned of high risk foods to eat and were treated as soon as onset of diarrhea occurred. During the weekends and off-hours, patients came to our hotel clinic for treatment and enrollment. There was always someone on call in case of emergencies. In a sense we as researchers were public health representatives during our entire stay.



The NSF-funded REU/RET (Research Experience for Undergraduates/Teachers) program at Ohio Wesleyan makes it possible for up to six students from universities across the country, as well as one or two high-school science teachers from central Ohio, to do research in the fields of astronomy, computer science, mathematics, and physics on the OWU campus.

Board 32

Linda Lee Kennedy
Columbus Public Schools

Faculty Mentor: Barbara S. Andereck
Department of Physics and Astronomy

We used adjustable metronomes on a movable platform to demonstrate synchronized motion through coupling. Many different platforms and configurations were used to measure the effect they had on the approach to synchronization of the coupled metronomes. An understanding of the synchronization of oscillators is of interest to investigators in a number of scientific fields. A previously unreported, significant variation in the metronome period en route to synchronization was noted along with an unwanted coupling due to fluctuations in the platform itself.

Synchronization of Coupled Mechanical Oscillators

REU/RET NSF Grant 0648751

The Kuramoto Model is used to describe synchronization of non-linear oscillators in biological, chemical, and physical systems. Using identical metronomes with similar frequencies on a movable platform as per J. Pantaleone [Am. J. of Phys. 70 (10) October, 2002] we hope to realize a mechanical example of this concept. A variety of movable platforms (balsa wood, aluminum, foam board, etc.) were used that provided coupling of the metronomes due to the fixed center of mass. Some platforms were allowed to roll on cylinders and some were suspended in pendulum fashion from the ceiling. PASCO photogates monitored by a LabView program written by Professor Thomas Dillman were used to determine the phase difference as two metronomes that began out-of-phase became synchronized. The dynamics of the metronome coupling were described by two second-order differential equations involving four key parameters: platform coupling, oscillation angle, damping/driving strength, and intrinsic frequency differences. In the process of aligning the experimental and theoretical results, we found the metronomes modulated their frequencies by varying amplitudes as the system moved toward synchronization. We also found that there appears to be additional coupling, due to transverse board fluctuations.

Board 33

Ryan Deskins
East Tennessee State University

Nalin Vutisalchavakul
Ohio Wesleyan University

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

Imaging Starspots on LO Pegasi via Light-curve Inversion

We present maps of the star LO Pegasi obtained via Light-curve Inversion. Light-curve Inversion is a technique which produces an image of a star's surface features based on variations in the star's observed brightness as dark "starspots" rotate into and out of view from Earth. In this research, we used this technique to map the spots on the surface of our target star, LO Pegasi. By analogy to sunspots, starspots are believed to be created by strong magnetic fields concentrated in specific regions in the uppermost layer of the star's convective zone, which constitutes the star's visible surface or photosphere. These intense magnetic fields suppress convection via interactions with electrical currents in the stellar plasma. Because convection is primarily responsible for transporting energy from the core to the outer portions of the star, this acts to cool the area and cause it to appear dark as compared to its surroundings. Our target star for this research, LO Pegasi, has a period of 10.17 hrs. The star's rapid rotation plays to our favor in that we can take images of LO Peg over the course of 3-4 nights and be confident that we have data points that cover a large portion of the star's brightness variations throughout its period. We obtained CCD images through four standard photometric filters: B (blue), V ("visual", which is green in appearance), red (R), and infrared (I). Doing so improved the latitude resolution of our maps. Once our data were collected, we then used Mira Pro to perform differential aperture photometry between our target star and a comparison star of constant brightness. The use of the comparison star compensates for apparent brightness changes of the target caused by variations in atmospheric conditions. We then analyzed the data using the Light-curve Inversion (LI) algorithm as implemented in a Fortran program written by one of us (Harmon).

Board 34

Megan Hallstrom

Case Western Reserve University

Faculty Mentor: Robert Kaye
Department of Physics and Astronomy

I measured the parity of the strontium-79 and yttrium-80 nuclei when they possess certain discrete energies. Parity is a spatial symmetry property that is either positive or negative depending on whether the nuclear matter distribution looks the same or upside-down in a mirror. Although my results for strontium-79 could only verify previous work, my measurements for yttrium-80 provided new information and confirmed previous speculation that this nucleus is very similar to other neighboring nuclei of its kind in the periodic table.

Parity Measurements in ^{79}Sr and ^{80}Y

Recently, a particular sequence of excited energy states in the ^{79}Sr nucleus has been shown to correspond to a very highly-deformed shape. From a theoretical standpoint, these excited states are expected to possess positive parity but this has not yet been proven through experimentation. Similarly, the most strongly populated sequence of states in the ^{80}Y nucleus is expected to have positive parity based on theoretical calculations and systematic evidence collected from other neighboring nuclei, but the parities have never been measured. This investigation was designed to measure conclusively the parity of as many excited states in ^{79}Sr and ^{80}Y as possible. The ^{79}Sr and ^{80}Y nuclei were produced at Florida State University following a fusion reaction between a beam of ^{28}Si ions accelerated to a kinetic energy of 90 MeV and a target of ^{54}Fe atoms. The linear polarization of γ rays that were emitted from ^{79}Sr and ^{80}Y following the reaction were measured based on how they preferentially Compton-scattered in three special "Clover" detectors. From these measurements, the known parity assignments in ^{79}Sr were verified, but conclusive parity assignments could not be made for the very highly-deformed states. However, a firm assignment of positive parity was made for the most strongly populated states in ^{80}Y, showing that this nucleus is very similar to its odd-odd neighbors in the periodic table.

Board 35

Joshua Schiffrin

Carnegie Mellon University

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

Based on an interest in quantum computing, the behavior of a superconducting element coupled to a micron-sized mechanical oscillator in an electric circuit was studied. The system could be treated like two blocks coupled together and on separate springs attached to walls. One of the block/spring systems was atypical in that it was modeled as a *nonlinear* oscillator. The stability of the nonlinear system when coupled to the mechanical oscillator was studied to see if the oscillator improved or weakened the stability of the nonlinear system.

Macroscopic Quantum Tunneling in a Damped Josephson Junction Coupled to a Nanomechanical Resonator

We studied the tunneling rate in a system consisting of a damped Josephson junction (JJ) coupled to a nanomechanical resonator. It has been proposed that such systems may one day be used as quantum bits, the primary components of quantum computers. To model our system, the JJ was regarded as a particle trapped in a metastable cubic potential well, and the resonator was considered to be a simple harmonic oscillator. As proposed by Caldeira and Leggett (1983), the damping on the system by the surrounding environment was modeled as two reservoirs of simple harmonic oscillators, one of which was coupled to the JJ, and the other coupled to the resonator. We used the Feynman path integral formulation of quantum mechanics, together with a semi-classical perturbation technique, to calculate the tunneling rate in our system. We found that damping the JJ suppresses the tunneling rate, a result already predicted by theory and verified by experiment for a single JJ. Our main new results for the coupled JJ - resonator system are: increasing the coupling strength between the JJ and the resonator suppresses the tunneling rate, while adding damping to the resonator actually enhances the tunneling rate. These results are important, as a low tunneling rate is essential for the proper operation of quantum bits.

Board 36

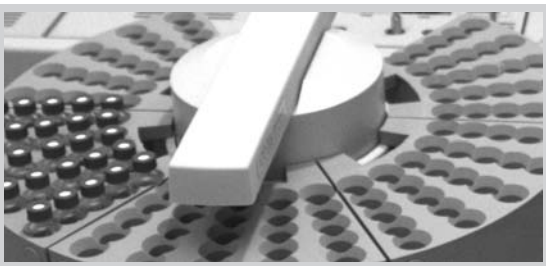
Tony Leguia
Grinnell College

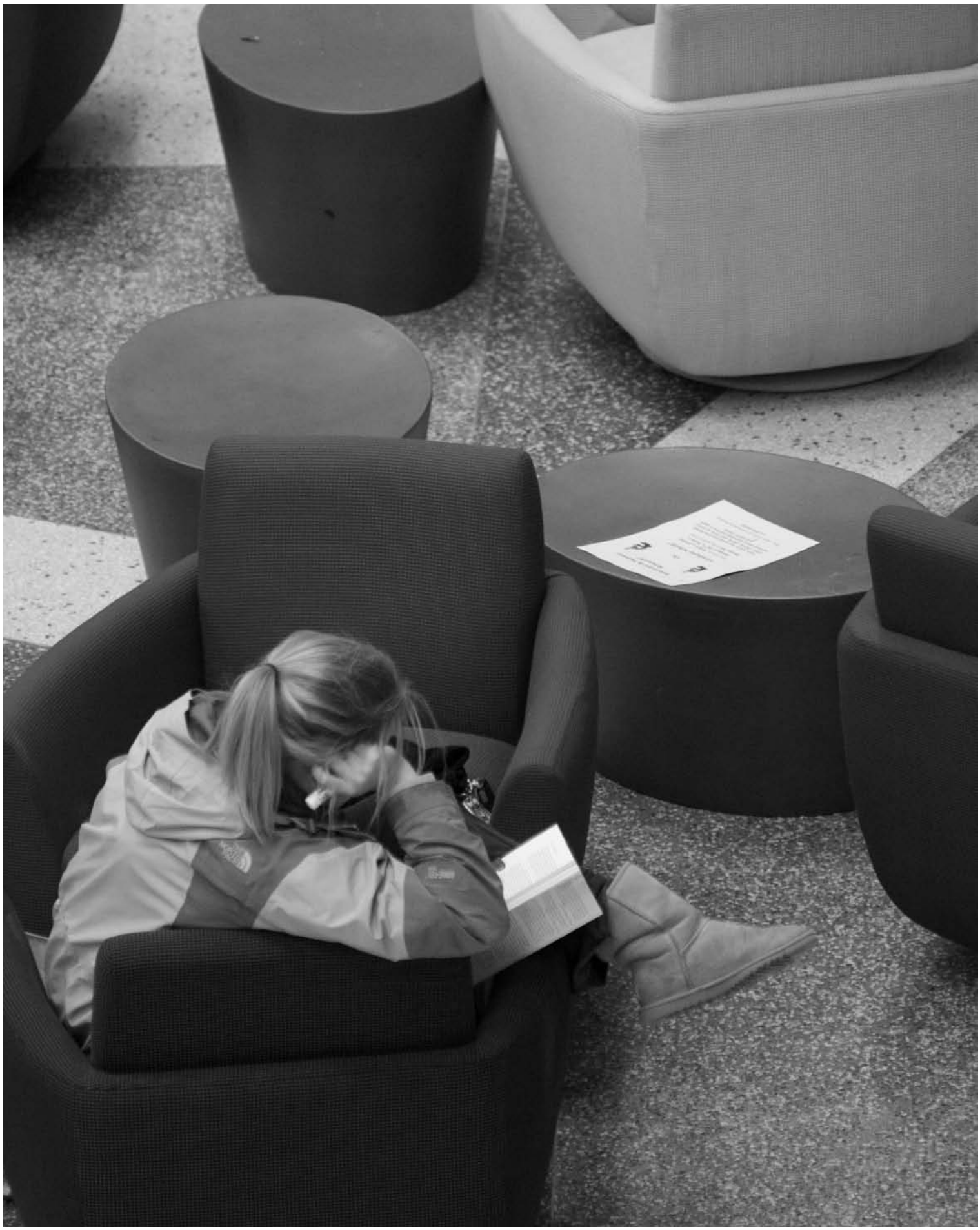
Faculty Mentor: Sean McCulloch
Department of Mathematics and Computer Science

We examined the problem of seating a classroom of students where each child provide the names of two enemies and two friends. The teacher must sit each student either next to at least one friend, or next to zero enemies. We examined several different variations of this problem, and have developed methods that will generate legal seating arrangements in each case.

Sorting Digraphs to Create a Seating Chart

We examined the problem of seating a classroom of students given a set of preconditions. The teacher has each child provide the names of two enemies and two friends. The teacher must seat the class so that every student is either sitting next to at least one friend, or is sitting next to no enemies. A solution to this problem can be found by modeling the children and their relationships as a directed graph with two kinds of edges. One type of edge represents the "friend" relationship and another type of edge represents the "enemy" relationship. An indifferent relation can be expressed by no shared edges between vertices, or by a third type of edge. We solved the one-dimensional case where the classroom is represented as a path by imposing a topological sort. We found that for digraphs of five vertices it is possible for no solution to exist. Additionally, we found that as the size of a digraph increases the likelihood of a solution increases since there are more indifferent relationships. For the two dimensional case we represented the classroom as a matrix. All two-dimensional classrooms that we tested found solutions. Finally, we also examined digraphs where the number of enemies and friends was parameterized and we characterized the form of the solutions of this type of digraph. Additionally, we explored graphs with additional preconditions imposed on the solution, such as mandatory seating positions and limitations.





Departmental Honors 2006-2007 »

Graduation with Departmental Honors requires an independent project, an oral exam on the project, and a comprehensive exam in a student's major department during his or her senior year. This program is open to students who have attained cumulative grade point verages of 3.5 in their majors after fall semester, junior year, as well as overall grade point averages of 3.0 or the support of their academic major departments, and have successfully petitioned the Academic Policy Committee at OWU.

Student Name	Department	Supervising Professor	Title
Jordanne Brown	Economics	Robert Gitter	The Effects of Migration on the U.S. Labor Market
George Hamaoui	Botany/Microbiology	Laura Tuhela-Reuning	Identification of Microbial Signatures in Biogenic Cave Ferromanganese Deposits
Sarah Kovit	Politics and Government	James Franklin	Immigration: Beginning, Middle, End, Past, Present, and Future
Katrena Kugler	Modern Foreign Languages	Sandra Harper	A Feminist Perspective: Roles Played in the Contemporary Spanish Marriage
Claire Martin	Physical Education	Nancy Knop	Alternative Education in Physical Education: A Review of Literature and Recommendations For The Future
Juliana Mecera	Religion	Blake Michael	Roman Catholic Liturgy After Vatican II
Amika Raksakul	Economics	John Boos/Barbara MacLeod	Rising China
Mian Rashid	Economics	Joann Harvey	International Accounting
Dana Reznik	Botany/Microbiology	Laura Tuhela-Reuning	Partial Feather Degradation by Microbes for Industrial Use
Douglas Sampson	History	Mark Gingerich	Kursk, Strategic Blunder and Tactical Arrogance: Exploring the Battle that Changed the Eastern Front
Slesh Shrestha	Economics	Saif Rahman	Temporal Model of Industry Fluctuations
Jillian Snyder	History	Jeremy Baskes	The Rise and Fall of Perón's Government in the 1940s



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Campus and Off-Campus Researchers

NSF-REU/RET Researchers

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Chartwells Dining Services
Faculty supervisors and student volunteers
Parents and guardians of student researchers

Where are they now? »

Success continues for OWU students who did research during the summer of 2006.

Yun Kyoung Claire Ryu

Presented Research: Sigma Xi National Research Conference - Detroit 2006,
American Physical Society - Jacksonville 2007
Currently: Beginning graduate work in biophysics at Johns Hopkins University

Philip Rademeyer

Currently: Intern, acting and playwriting at off, off Broadway theater in New York, New York

Julie Peterson

Presented Research: Sigma Xi National Research Conference - Detroit 2006
Currently: Beginning graduate work in entomology at the University of Kentucky

Marie McNeely

Presented Research: Sigma Xi National Research Conference - Detroit 2006
Currently: Spent summer at the West Virginia University Center for Neuroscience doing research in neuroimaging and social cognition research.

Alex Paya

Currently: Spent summer at the University of California-Riverside doing research at the Institute of Plant Research

Rachael Roettenbacher

Presented Research: American Physical Society meeting 2006,
Sigma Xi National Research Conference - Detroit 2006,
American Astronomical Society - Seattle 2007
Currently: Spent summer at Lehigh University doing research involving atomic and molecular phyiscs

Christopher Earl

Presented Research: ACM Student Research Competition) at SIGCSE 2007 (Special Interest Group on Computer Science Education)
Currently: Spent summer doing research at the University of South Florida

Ryan Yoder

Presented Research: American Chemical Society National Meeting - San Francisco 2006,
Sigma Xi National Research Conference - Detroit 2006

Dan Albert

Currently: Beginning graduate work in physical chemistry at the University of Wisconsin-Madison

Dana Reznik

Presented Research: American Society for Microbiology - Toronto 2007
Currently: Beginning graduate work in microbiology at Michigan State University

George Hamaoui

Presented Research: American Society for Microbiology - Toronto 2007
Currently: Beginning graduate work in microbiology at the University of Massachussetts-Amherst

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