Ohio Wesleyan University

PATRICIA BELT CONRADES
Summer Science Research Symposium

SEPTEMBER 17, 2012

NASIE CONSTANTINO

OWU '12, GRADUATE STUDENT AT TEXAS A&M UNIVERSITY

"Not only did the SSRP give me the experience I needed to get into a Ph.D program at Texas A&M, it gave me the confidence and the drive to do it."

THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM

Science, mathematics, and technology continue to increase in importance as the world becomes smaller and more interdependent. Through ongoing research, scientists can help solve global problems—from eradicating infectious diseases to discovering new sources of clean, safe energy.

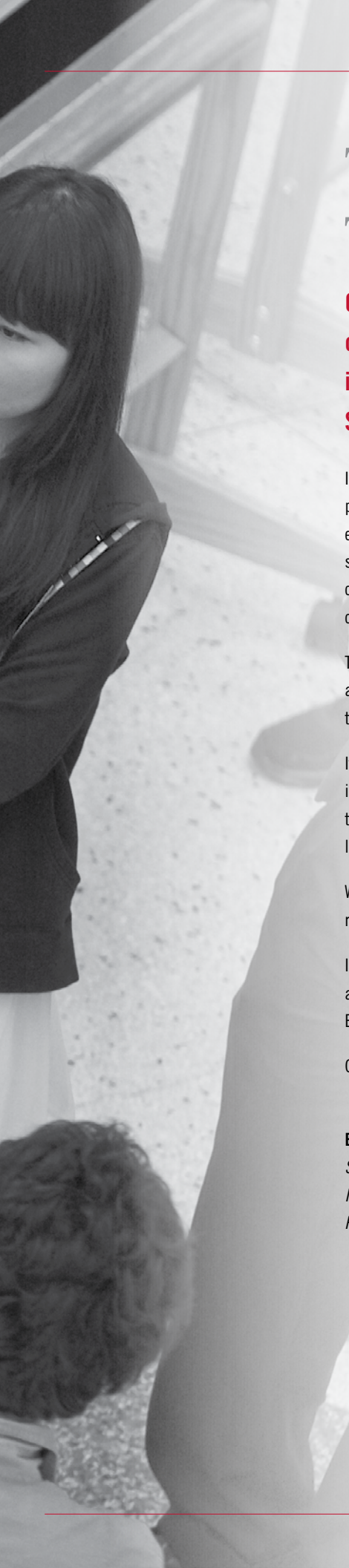
Now in its twentieth year at Ohio Wesleyan, the Summer Science Research Program, which culminates in today's Patricia Belt Conrades Summer Science Research Symposium, encourages students to tackle tough research issues by offering an intensive 10-week opportunity to work with seasoned, accomplished mentors both on and off campus. The posters you see here today depict the research results. Please ask the students any questions you wish; they are proud and happy to tell you what they learned and why it matters.

Contents

Atrium, Schimmel/Conrades Science Center

Monday, September 17, 2012 at noon

Opening remarks by President Rock Jones followed by student poster presentations



Thoughts from the Director

Ohio Wesleyan University encourages students to take the theory learned in the classroom and put it into practice in the real word. While many new curricular initiatives are providing these opportunities for all OWU students, the Summer Science Research Program (SSRP) has been modeling this concept for two decades.

In this rich and varied program, students spend ten weeks in the summer working side by side with faculty mentors on research projects that are connected to the students' particular scientific interests. At larger institutions, undergraduate students join an existing research group consisting of graduate students and post-doctoral fellows. At Ohio Wesleyan, that's not the case. Here, students are the central researchers in their projects. They participate in all the steps of the research process, taking ownership of the successes, the failures, and the knowledge gained. Throughout this process, they grow into mature, self-directed, confident investigators who add their own pieces of knowledge to the greater body of scientific understanding.

Today, the students participate in another very important part of scientific work: explaining their research posters to scientists and nonscientists alike. As you talk with the students, you will appreciate the depth of their understanding. They can explain their work because they understand the fundamentals of the project and have recognized and pondered its nuances.

It's probable that many of these students will present again at major meetings of national scientific societies, interacting the most prominent scientists in their fields of interest and making the connections that will help them as they further their work in graduate school or in an immediate scientific career. Today may mark the first step in a long lifetime of professional achievement.

We are grateful to Dr. Nancy Schneider '64 for providing the endowed funds that make this celebration of scholarship a reality each year.

In the following pages, you'll meet Ohio Wesleyan students who conducted research both on and off the campus, as well as students from other colleges who carried out research on our campus under a National Science Foundation Research Experiences for Undergraduates (REU) Grant awarded to our faculty in physics, astronomy, computer science, and mathematics.

Congratulations to all who participated in this exceptional research program.

Barbara Andereck
Summer Science Research Program Director
Interim Dean of Academic Affairs,
Professor of Physics and Astronomy

The Making of a Scientist

In Ohio Wesleyan's Summer Science Research Program (SSRP), students learn quickly that authentic research is quite different from classroom labs—more challenging, more creative, more frustrating, and, ultimately, more rewarding.

I have always actively involved students in my research projects during the academic year and during the summers. The most rewarding part is watching the students grow as scientists, seeing them take command of a research project, and knowing that they are gaining the confidence to speak and act as scientists. Science cannot be learned solely from a book. Science must be experienced through research, and at OWU, we encourage students to plunge in, preparing them to be successful researchers both at OWU and at other universities. Many first-year students are surprised to learn that they can contribute to substantive scientific research from the moment they arrive on campus. At Ohio Wesleyan, research is not just for the few.

During the Symposium this afternoon, you will have the opportunity to interact with 23 students who performed research at OWU mentored by OWU faculty members, eight students from universities other than OWU who worked on campus with OWU faculty, and 15 OWU students who performed research off campus at other universities or in other countries. There is no doubt that the results presented here today are exciting and novel. However, equally exciting is the opportunity for you to speak with each of these young scientists about what discoveries they have made.

Enjoy the Symposium—and be sure to learn something new!

Laura Tuhela-Reuning
Department of Botany-Microbiology
Department of Zoology
Scanning Electron Microscopist
Summer Science Research Program Assistant Director



THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM ENDOWMENT

In 2006, Dr. Nancy Reynolds Schneider '64, established an endowment to name the Summer Science Research Symposium after her good friend and fellow OWU alumna, Patricia Belt Conrades '63.

Mrs. Conrades 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 Mount Auburn Hospital. Dr. Schneider is 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 also has served on the Ohio Wesleyan Board of Trustees.

Mrs. Conrades and Dr. Schneider share a commitment to the sciences, and are both examples of individuals who have enjoyed successful careers in science. The support of Mrs. Conrades and her husband, George Conrades '61, a member of the OWU Board of Trustees, and Dr. Schneider and her husband, John Schneider, continues to strengthen the science and mathematics programs at OWU.

THE C. PATRICIA FERRY SUMMER SCIENCE RESEARCH PROGRAM ENDOWMENT

In 2008, Patricia Ferry '53 established the C. Patricia Ferry Summer Science Research Endowment in recognition of the program's value as an integral part of the liberal arts experience. The endowment that will fund the program in perpetuity follows Ms. Ferry's support of the program through gifts she has made annually for several years.

Through her contacts with SSRP participants, Ms. Ferry has observed how the program introduces students to the excitement of science and original research and provides familiarity with the many career options available in the disciplines.

Ms. Ferry's interest in the sciences is long standing including her years at Case Western Reserve University where she worked in the medical school directing its medical education program. She graduated from Ohio Wesleyan with majors in psychology and sociology and as a member of Alpha Xi Delta sorority.

Special Acknowledgments

Sources of Support for the 2012 Summer Science Research Program

Harry Phillip Bahrick Summer Research Fund
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The Student-Faculty Endowed Research Fund in Chemistry
Ohio Wesleyan University Provost and Academic Affairs Office

Support for the Patricia Belt Conrades Summer Science Research Symposium

Dr. Nancy Reynolds Schneider '64


Bloodworms

Board 1

BEN LETSON

Faculty Mentor: Mark Schwartz
Department of Mathematics and
Computer Science

The subject of optimization has intrigued mathematicians for centuries; we take a fresh look at two medieval math problems, the "Museum" problem and the "Muddy Wheel" problem. How far should a dedicated museum patron stand from a Monet to maximize his view of the Water Lilies? If you're riding a cart on a muddy path, where should you sit to avoid the splash zone of the mud leaving the wheels? By studying these questions and their generalizations we discover remarkable structures underlying the problems, and find new ways to understand the answers.

GEOMETRIC AND DIFFERENTIAL GEOMETRIC OPTIMIZATION

We consider two generalized, geometric optimization problems from classical mathematics, the Regiomontanus problem and the Muddy Wheel problem. The first is a famous calculus optimization problem. Given a painting on a wall in front of you, where is the best place to stand to get the "best view", i.e. maximize the viewing angle? Our solution procedure sheds light on the known, but cryptic, algebraic result and involves the construction of the antiorthotomic, a common differential geometric tool. The procedure is generalizable to a large set of other problems such as: where is the best place to stand on Saturn to see its rings, how far should a gentleman stand away from a mirror to best view his trousers, and where is the best place to sit on a hill to watch fireworks? The Muddy Wheel problem fascinated peasants for hundreds of years; imagine a wheeled cart moving briskly through thick mud, with the mud flinging off of the wheel in all directions. The natural question arises, how high does the mud travel? The question is then generalized by imagining all different shapes of wheels (most don't promise a smooth ride). Newtonian physics is used to model the parabolic paths of the mud particles. New differential geometric tools such as the "vertex path", the curve that passes through the vertices of the parabolae, and familiar geometric curves appear naturally in the solution procedure. In both problems, taking a new look at old questions provides startlingly beautiful drawings, curves, and optimal solutions.

Board 2

KRISTIN SCHWACHA

Faculty Mentor: Tami Panhuis
Department of Zoology

P. turneri is a species of fish that gives live birth to its young, which develops a placenta-like tissue for the delivery of nutrients to the fetus. The alpha-2 macroglobulin (A2M) gene produces an extremely versatile immunological molecule that may be involved in interactions between the mother and developing fetus. We have been developing an experimental setup called a Southern blot to find out more about the A2M gene, specifically to determine if there is more than one copy of the A2M gene present in each individual *P. turneri* fish. Further testing is needed to produce conclusive results.

POECILIOPSIS PLACENTA GENES: IS THERE DUPLICATION IN THE A2M GENE?

Poeciliopsis turneri is a species of live-bearing fish that produces a placenta-like structure during pregnancy to transfer nutrients from the maternal bloodstream to the fetus. One highly expressed gene in these fish placentas, also found highly expressed in mammalian placentas, is the protease inhibitor alpha-2 macroglobulin (A2M). This protease inhibitor has the potential to interact with a wide variety of molecules and could potentially be involved in the maternal-fetal conflict model of protein evolution. This model describes the evolution of elaborate interactions between maternal and fetal proteins due to a potential intergenomic conflict of interest. We sought to determine if the A2M gene is duplicated in the *Poeciliopsis* genome, as has been found for other bony fish. If A2M were duplicated, then the multiple copies of the gene would allow for the potential for a more versatile functionality of A2M, increasing the likelihood that it could play a role in a maternal-fetal conflict. To determine if A2M is duplicated, clones were generated from the placenta cDNA of a single *P. turneri* individual and sequenced. Analysis of these clone sequences showed a relatively high amount of heterogeneity, suggesting that A2M may be duplicated. A protocol was devised to conduct a Southern blot in order to confirm whether A2M is duplicated in *P. turneri*. Preliminary trials have been conducted to test the experimental setup and have shown that the A2M gene-specific probe recognizes the positive control. We have also tested both chemiluminescent and chromogenic methods of probe detection and we believe that the chromogenic might be less sensitive than the chemiluminescent, so we will move forward using the chemiluminescent approach.

Board 3

PYIK THAT NWE

Faculty Mentor: Katherine Hervert
Department of Chemistry

Disulfide-reducing agents are commonly used in biochemistry to reduce disulfide bonds that exist in proteins. A potent, stable reducing agent, Dithiobutylamine (DTBA), was synthesized from L-aspartic acid, which is an abundant amino acid through a high-yielding five-step synthetic scheme, capable of large-scale process.

SYNTHESIS OF DITHIOBUTYLAMINE, DTBA, A DISULFIDE-REDUCING AGENT

Human body is predicted to contain the highest percentage of extracellular proteins with disulfide bonds. Disulfide-reducing agents such as dithiothreitol (DTT) are commonly used in biochemistry to reduce these disulfide groups and hinder the oxidation of thiol groups in proteins. However, >99% of DTT thiol groups are unreactive at neutral PH due to protonation. Hence, a more potent, stable reducing agent, dithiobutylamine (DTBA), was synthesized from L-aspartic acid through a high-yielding five-step route. This synthetic scheme has also been transfigured to produce DTBA as its HCl salt on a large scale.

Board 4

TYLER SHEETZ, JENN WALLACE, AND SARAH WELLS

Faculty Mentors: David Markwardt
and Scott Kelly
Department of Zoology

Previous studies support the importance of diet, weight, and exercise in the onset and progression of colon cancer, one of the deadliest forms of human cancer. We are investigating how mice that have been selectively bred for *high levels of voluntary physical activity* respond to a carcinogen known to cause colon cancer. We hypothesize that these mice have evolved genetic changes that will delay or prevent colon cancer onset and progression.

COLON TUMORIGENESIS IN MICE SELECTIVELY BRED FOR HIGH VOLUNTARY WHEEL RUNNING

Previous research has shown that mice forced to exercise show a reduction in the severity of colorectal cancer. In this study we have used mice selectively bred for high voluntary wheel running (known as high runner or HR mice) to examine the effect of voluntary exercise on colorectal cancer susceptibility and progression. The >60 generation selection experiment has produced four HR lines that have diverged significantly from control lines with a 2.5- to 3.0-fold increase in total revolutions run per day. Selection history has caused the HR lines to diverge in a number of morphological, physiological, and behavioral traits including (but not limited to) reduced body fat, increased circulating adiponectin, decreased circulating leptin, and increased home-cage activity. Using the four different HR lines (each with some uniquely evolved traits) and one control line, we injected Azoxymethane (a known carcinogen that acts specifically on the colon) over the course of 6 weeks. A total of 16 mice from each HR line were used in the study, as well as 32 control mice (half males, half females). The different lines were inter-housed and received identical treatment to eliminate potential confounding variables. Red and white blood cell counts were measured every 6 weeks to monitor changes in overall health. In addition, we used endoscopy to monitor and quantify tumor onset and progression. Five months following the first injection, colons will be dissected, tumor number and size recorded, and tissues processed for further histological and molecular evaluation.

Board 5

SARAH WELLS, JENN WALLACE, AND TYLER SHEETZ

Faculty Mentors: Scott Kelly
and Dave Markwardt
Department of Zoology

It is well known that the early life environment can have an effect on traits shown in adult life. With increasing obesity rates, we are interested in the effects of maternal exercise during pregnancy and offspring diet on adult behavior and physiology. Specifically, we investigated the effects of exercise during pregnancy and the effects of high-fat diet at an early age on adult willingness to exercise, the ability for change in body composition, and capability to lose weight after exercise. Through translational research using a mouse model, our ultimate goal is to provide a broader knowledge base for exercise and diet guidelines during pregnancy and early development.

EFFECTS OF EARLY-LIFE EXPOSURE TO EXERCISE AND HIGH-FAT DIET ON ADULT PHENOTYPES

This study was a two-part study addressing how the early-life environment affects adult phenotypes. The first part of the study examined the effects of maternal exercise during pregnancy on body composition, the predisposition of offspring to voluntarily exercise, and the change in weight and adiposity in response to exercise. Females were separated into three groups: no exercise, post-weaning only and post-weaning and gestational exercise. Females were mated and their offspring had their body composition assessed throughout development and voluntary physical activity was measured at 9 weeks of age for 6 days. The second part of the study examined the effects of early-life exposure to high-fat diet on adult exercise propensity, weight loss, and changes in blood lipid profiles. For this study, female mice were weaned into three different experimental conditions: regular diet, high-fat diet, and variable diet (alternating between regular and high-fat diet every three days). Food consumption and weight of each mouse was monitored for eight to eleven weeks before wheel access was given. Blood samples were taken before and after wheel access to evaluate blood lipid profiles, and post wheel access adipose, liver, and ventricle weight were measured for each mouse.

Board 6

IFTEKHAR A. SHOWPNIL

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

The study of root architecture is very important in plant research as the roots provide the plants with nutrients and water. In addition to internal developmental cues, roots show a developmental pattern in response to environmental stimuli like light, gravity, touch, etc. Our research this summer is focused on studying the effects of a class of auxin transporting proteins (PINs) on the root's growth response to *gravity* in the model plant *Arabidopsis Thaliana*. By understanding the role these proteins play in the root's growth response, we hope to identify master regulators of root architecture that could prove useful in improving crop plants.

INVESTIGATING THE GRAVITROPIC GROWTH RESPONSE OF PIN SINGLE AND DOUBLE MUTANTS *(PIN3, PIN4, PIN7, PIN3PIN7,* AND *PIN4PIN7)* UNDER A CONSTRAINED STRESS CONDITION

Plant organs exhibit unique growth responses to individual environmental stimulus like light, gravity, and touch. In the presence of a gravitational field, the roots of plants perceive and orient themselves with the gravitational field. The roots show a tip curvature growth response, when gravistimulated at an angle, in order to reorient itself with the gravitational field. This tip curvature is caused by differential growth of the cells in the root tip due to asymmetrical distribution of auxin within the root cap. The PIN family of proteins is known to act as auxin efflux carriers in the root cap and hence plays a role in the root's curvature response. Most of the previous reports on these pin mutants describe weak mutant phenotypes, presumably recovered by functional redundancy. In this experiment, pin single and double mutants were gravistimulated at constrained angles in order to maintain a constant stress as the root grows. This showed a significantly strong mutant phenotype in both the single and the double mutants. At constrained angle of 30 degrees, the mutants registered significantly smaller rates of curvature from the wild type after the first hour of gravistimulation. When gravistimulated at constrained angles larger than 30 degrees, the mutants show pronounced defects in response rates as compared to the wild type response at all time points, suggesting a significant role for PIN proteins in gravity perception in the roots. Additionally, we investigated a generalization of a Nash Equilibrium, and attempted to find a Strong Nash Equilibrium (SNE) for the graph. We found this to likely be NP-Complete, and that SNE are not guaranteed to exist for all graphs.

Board 7

RACHEL G. THOMAS

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

Bacteria could have an unexpected and currently unexplored role in evolution. Certain birds may be selected to reproduce and evolve based on how resistant their feathers are to bacterial degradation. Studies show that darker feathers with more melanin pigment are more resistant than lighter feathers to bacterial degradation. We are studying the possible antibacterial effects of two specialized non-melanin feather pigments, only found in an African bird called the Turaco. Experimenting with non-melanin pigments may shed more light on how different birds have evolved over time.

BIRDS AND BACTERIA: ANALYZING THE RELATIONSHIP BETWEEN SPECIALIZED PIGMENT AND FEATHER STRENGTH

Bacillus licheniformis degrades feathers but darker, melanized feathers are more resistant to degradation than lighter feathers (Goldstein *et. al*, 2004). African Turacos produce unique pigments, turacin and turacoverdin, not found elsewhere in nature. To determine if the pigments inhibited bacterial degradation, we placed a red, unleached, and leached turaco feather separately into media, inoculated with *B. licheniformis*, and sampled for 15 days. Oligopeptide concentration (OC) in the leached feather medium increased over time (R^2=0.8064) while OC in the unleached feather varied but generally decreased (R^2=0.1738) over time. To characterize the feather pigments, we extracted turacin and turacoverdin from Lady Ross's Turaco (*Musophaga rossae)* feathers. Both pigments leached from feathers in basic solutions. UV/Vis indicated that turacin peaked at 680, 405, and 340 nm while turacoverdin peaked at 395, 340, 260, 240, 220, and 205 nm. Thin layer chromatography (TLC) yielded R_f= 0.489 for turaco and R_f=0.446 for turacoverdin. Turacin's IR peaked at 3448, 2925, 1718, and 1655 cm^{-1} while turacoverdin peaked at 3424, 2924, 1701, and 1655 cm^{-1}. Energy-dispersive spectroscopy (EDS) indicated copper present in five of seven red feather samples. Six of eight green and blue samples contained nickel but no copper, and one sample had copper and nickel.. The pigments have distinct absorbance spectra but similar IR peaks indicating that turacoverdin contains alkanes, alkenes, carboxylic acids, and amines. The pigments differ little in polarity with similar R_f values. EDS confirmed copper's presence in turacin. Nickel's presence and copper's frequent absence suggests that turacoverdin may not be copper-based like turacin.

Board 8

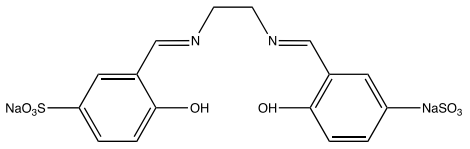
TREY JOHNSON

Faculty Mentor: Kim Lance
Department of Chemistry

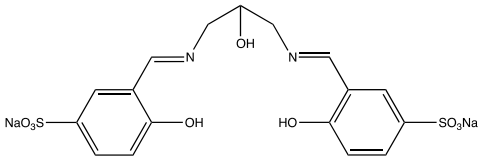
Iron Chlorosis is a disease in which plants do not receive the right amount of iron from the soil due to the solubility of Iron. In the fertilizer industry, chelates are used to bind to the iron in the soil and render the ferrous ion absorbable by the plant. Dr. Lance and I are synthesizing three different chelates in order to test their effectiveness of transferring Iron to iron-deficient plants versus a commercially available fertilizer, EDTA.

PREPARATION OF AGRONOMICALLY RELEVANT IRON(III) CHELATES

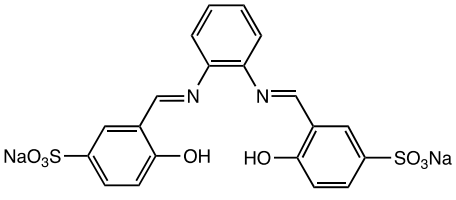
Iron chelates are used in the agriculture industry in order to alleviate Iron Chlorosis, a disease in which plant roots are unable to extract iron from the soil due to solubility. These chelates are designed to solubilize the iron and allowing it to be absorbed by the plant roots. This summer various ligand systems were synthesized in order to deremione their effectiveness of transferring iron to the plant, compared to the commercial agent, EDTA. Two ligand systems were successfully synthesized, in fairly high yield: ligand 1, an ethylenediamine derivative, and ligand 2, a derivative of 1,3-diamino-2-propanol, shown below. Ligand 3, an o-phenylenediamine derivative, is still under investigation.



Ligand 1



Ligand 2



Ligand 3

Board 9

CLARE EDWARDS AND VICTORIA SELLERS

Faculty Mentor: Jennifer Yates
Department of Psychology

Each year, 12,000 Americans suffer from a traumatic spinal cord injury, which can result in paralysis and loss of sensation. These deficits are exacerbated by inflammation, a natural immune response to trauma. One chemical released by activated immune cells is quinolinic acid, which can cause neuron death. We are using different doses of 6-Chloro-Tryptophan to inhibit the production of quinolinic acid in a guinea pig model of spinal cord injury. Hopefully, this intervention will decrease the amount of quinolinic acid at the injury site and increase functional recovery.

DOSE-RESPONSE INVESTIGATION OF 6-CHLORO-TRYPTOPHAN IN REDUCING SECONDARY DEFICITS FOLLOWING SPINAL CORD INJURY

Traumatic spinal cord injury often results in motor and sensory functional deficits, affecting quality of life. Following initial injury, a number of pathological processes can cause secondary deficits, worsening overall function. One mechanism by which this can occur is inflammation; activated immune cells release a number of chemicals at the affected area, including the neurotoxin quinolinic acid (QUIN). 6-Chloro-Tryptophan (6Cl-Trp) has been shown to interrupt the synthesis of QUIN, and therefore may attenuate these secondary deficits. In order to assess the efficacy of 6Cl-Trp, female Hartley guinea pigs received an experimental lateral compression injury to the spinal cord at thoracic level 12. Animals received intraperitoneal injections of vehicle solution, 30 mg, or 60 mg of 6Cl-Trp beginning five hours post-injury and continuing every twelve hours through post-injury day 14. A variety of motor and sensory behavioral assessments were used to evaluate functional recovery. Traditional functional measures including proprioceptive placing, hind limb toe spread, and cutaneus trunci muscle response were supplemented with recently-adapted behaviors including contact righting, air righting, and incline plane. Control animals did not show the pattern of motor and sensory functional changes following injury seen in previous studies. Challenges in maintaining animal facilities at an ideal temperature and noise level may have caused psychological and physiological stress, thereby altering immune function in all animals, contributing to this discrepancy.

Board 10

CHELSEA R. DENNIS

Faculty Mentors: Laura Tuhela-Reuning[1] and Kristina Bogdanov[2]
[1]Department of Botany-Microbiology,
[2]Department of Fine Arts

According to the World Health Organization (WHO) 3 children die every minute due to diseases caused by drinking contaminated drinking water. In my research I filtered contaminated water through porous clay filters to remove bacteria that indicate fecal contamination. These bacteria are the main causes of disease in people who drink contaminated water. Further, we wanted to see if colloidal silver would kill bacteria that were not initially removed. We want to make it possible for people in third world countries to have access to clean drinking water.

CLAY FILTRATION AND BACTERIAL REMOVAL: AN EXTENSION OF POTTERS FOR PEACE

The World Health Organization estimates three children die every minute from diseases caused by drinking contaminated water. Bacteria in fecal contamination cause many human gastrointestinal diseases so coliforms and Enterococci are used as bacterial indicators of fecal contamination in water. We used different Red Art clay formulations to produce inexpensive ceramic filters such as those used by the Potters for Peace organization and tested these filters to evaluate their effectiveness in removing coliforms and Enterococci from water. In addition, some filters were coated with 0.01% colloidal silver to enhance removal of fecal indicators from water. Clay filters were first soaked in tap water before use as filters. Filtered and unfiltered water from the Delaware Run were tested for coliforms and Enterococci on mColiBlue and mEI media, respectively. A continuous use filter was tested once weekly for 10 weeks to see how long the filter remained effective. Colloidal silver (0.1%) solution was painted onto the interior of some filters and air-dried before filtering source water. Plates of mColiBlue and mEI were incubated for 24 hours at 37°C. An average of 98.5% of coliforms were removed from the source water using the continuous use filter. An average of 95.59% of coliforms and 100% of Enterococci were removed from the filters without silver present, and 95.31% of coliforms and 68.22% of Enterococci were removed from these same filters painted with the silver solution. The silver concentration in the filtered water was approximately 5 ppb. Data indicate that ceramic filters were effective at removing an average of 98.5% of coliforms from contaminated water. However, silver-coated filters removed 95.59% of coliforms and 68.22% of Enterococci. The filtered water had a silver concentration of 5 ppb, which is below the EPA limit of 100 ppb silver in drinking water.

Board 11

FRANK KUSHNAR-SANDERSON

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

Iron is an important nutrient plants require for growth and development. Normally iron is not very accessible in the soil to plants so they expend energy to forage for iron. We used molecules called chelators that bind the iron up and allow the plant greater access to it. We rotated the plants by 45° to induce a change in their initial root angles and measured the degree of curvature for each root over 24 hours.

LATERAL ROOT ARCHITECTURE OF *ARABIDOPSIS THALIANA* UNDER THE INFLUENCE OF SYNTHETIC IRON CHELATES

Iron is an important micronutrient necessary for plant development and growth that is normally insoluble in soil (Long et al., 2010). Lateral root tips take in iron by highly regulated mechanisms (Giehl, Lima, & Von Wiren, 2011). Synthetic iron chelators have been targeted as one potential way to make iron more accessible to the plant. (Hasegawa et al., 2011). Our experiment sought to answer two questions: whether the response of lateral root architecture to gravitropic stimulation was a suitable screen for the effectiveness of chelate binding and how does the gravitropic response of lateral roots change with changes in iron accessibility. Col-0 (WT) *Arabidopsis thaliana* seeds were grown for 10-12 days with the primary root 90° from the horizontal on ½ MS media prepared from scratch. Fe(III)-EDTA or an ethylenediame derivative were substituted in place of ferrous sulfate heptahydrate at 100 uM to make two different derivations of normal media. After this growth period, the plates were scanned and imaged for 24 hours after being gravistimulated at 45°. Root tip angles were measured over the 24-hour period to yield overall curvature from initial set-point angle. Chlorophyll concentrations were measured as an indirect indicator of iron concentration in the plant. Our results indicated that the Fe(III)-EDTA and Chelate media plants held a more horizontal set-point angle before stimulation. These plants also reached their new set-point angles faster than the normal media plants after being rotated. No significant differences were found in chlorophyll levels. We concluded that lateral root architecture has the potential to be a suitable screen for chelate effectiveness. Future steps of this research include looking at proteins specifically involved in iron uptake and their reaction to synthetic chelates.

Board 12

ETHAN PERRY

Faculty Mentor: John Krygier
Department of Geology and Geography

Pocket gopher burrows often have insects living in them alongside the gophers. These gophers can be difficult to find. Using Geographic Information Systems (GIS) we are able to make maps using factors we know are suitable for gophers. These maps can help scientists easily see where the gophers and insects are likely to be found.

GIS & NICHE MODELING OF POCKET GOPHER BURROWS TO PREDICT THE LOCATION OF GOPHERS AND SYMBIOTIC INSECTS

Diverse insects live symbiotically with pocket gophers in their burrows. New species of burrow-sharing insects continue to be identified thorough fieldwork. A significant challenge is locating pocket gopher burrows. Mapping and Geographic Information Systems (GIS) are a promising approach to locating gopher burrows by modeling the environmental factors favorable to burrow construction. Pocket gophers choose particular habitats: wet, low-lying areas are poorly suited, while higher elevation well-drained areas support burrows. GIS can be used to analyze geological, soil, and physiographic data to determine particular areas suitable for pocket gopher burrows. The result, maps of potential pocket gopher habitat, can guide and focus fieldwork seeking additional burrows and the insects that dwell in them.

Board 13

RIANE RAMSEY AND ELLEN DEFENDERFER

Faculty Mentor: Lynda Hall
Department of Psychology

Very few studies have examined long term memory for a second language as a function of cognitive aging. Our study will determine the relationships among accessibility of knowledge, education, age, and reading comprehension in one's second language. The results of our study may provide new information about the role of accessibility in reading performance in young and older adults.

COGNITIVE AGING AND ACCESS TO KNOWLEDGE: SPANISH READING COMPREHENSION

Previous research conducted by Bahrick, Hall, and Baker at Ohio Wesleyan University has demonstrated that the ratio of accessible knowledge to available knowledge (the A/A ratio) is sensitive to age related changes in memory. For example, relative to middle age adults, older adults showed declines in accessibility of names of famous people, but not vocabulary from a second language. For both age groups, accessibility shows a strong monotonic relationship with availability such that individuals with more available knowledge are also able to access a higher proportion of that knowledge on a recall test. The purpose of the present investigation is to determine if this ratio predicts performance on a task that involves more complex cognition, reading comprehension in a second language (Spanish). In children, reading comprehension has a strong relationship with another measure of access, the speed with which individuals can name familiar symbols such as letters or digits (Kail & Hall, 1994). Generally, naming speed is not related to reading comprehension in adults; however it may be sensitive to reading comprehension in a second language. In addition, adults may employ different reading strategies when reading in a second language, which is one aspect of their metacomprehension abilities. We will investigate whether the A/A ratio accounts for variability in reading comprehension that goes beyond that provided by naming speed and available knowledge. In the present study, participants will take an introductory level Spanish vocabulary test, two naming speed tests, a metacomprehension questionnaire, and a Spanish reading comprehension test. Data will be analyzed via hierarchical regression with processing speed and available knowledge (vocabulary recognition) as control variables and age and A/A ratio as the variables of interest. These models will be used to predict Spanish reading comprehension performance.

Board 14

ELIZABETH HERDER

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

Some species of rod shaped bacteria, or *Bacilli*, produce an enzyme that allows them to degrade bird feathers and also have special appendages, or flagella, that allow them to swim. In this project, a microscope was used to estimate the percentage of bacteria that were moving of specific species. After this, these same bacterial species were put into test tubes with feathers and the amount of feather degraded by the bacteria was quantified using a spectrophotometer. These were graphed against each other to see if there was a correlation between the rate of feather degradation and motility of feather degrading species. No correlation was found, but the rate of feather degradation was almost the same across the species each day.

CORRELATING MOTILITY OF *BACILLUS* SPP. FROM SONGBIRD PLUMAGE TO THEIR FEATHER DEGRADING ABILITY

Among the bacteria present on songbird plumage are species of *Bacillus* that degrade feathers and can survive on the nutrients gained on feathers as they break down the β-keratin. These *Bacillus* species are motile via their flagella, and their motility may play a role in their ability to degrade feathers. Ohio Wesleyan has an extensive culture collection of *Bacillus* spp. isolated from songbird plumage. The motility of thirty feather-degrading *Bacillus* spp. from this collection was evaluated by observing the percentage of motile cells in a wet mount of a 24 hour culture. The feather-degrading ability of the same isolates was quantified by inoculating sterilized feather medium tubes and incubated at 37°C. Daily aliquots of the medium were collected, centrifuged to remove any feather debris or cells, and measured for absorbance at 230 nm to quantify the amount of oligopeptides in the medium. During a lag phase of three days, there was no positive correlation between motility and feather degradation by the *Bacillus* spp. Once in log phase, the bacteria exhibited a slightly positive correlation with the strongest being on day four ($R^2 = 0.032$). While these data do not show a strong correlation, all *Bacillus* strains had similar rates of feather degradation for each day throughout the trial. The data suggest that the more motile the *Bacillus* spp., there may be a better ability for the bacteria to degrade feathers. The data also indicate that all the *Bacillus* spp. tested degrade feathers at the same rate after the first 24 hours.

Board 15

MARY ANN (JUNG HYUN) LEE

Faculty Mentor: Shala Hankison
Department of Zoology

Sexual selection is a major driving force of diversity in nature. One factor influencing mate choice is the major histocompatibility complex (MHC). MHC is a diverse gene region that regulates the immune system. Three hypotheses have explained the mechanisms of how MHC influences sexual selection: inbreeding avoidance, maximizing MHC diversity, and balancing selection. We attempt to distinguish between the different mechanisms using a model organism in sexual selection, the sailfin mollies. The findings are potentially applicable to understanding how MHC influences mate choice in nature, as well as in humans.

INFLUENCE OF MHC (MAJOR HISTOCOMPABILITY COMPLEX) ON MATE CHOICE IN THE SAILFIN MOLLY, *POECILIA LATIPINNA*

The major histocompability complex (MHC) is a polymorphic gene family involved in immune response regulation. The diversity of the MHC region is driven and maintained by many factors, one of which may be sexual selection. Different combinations of MHC alleles resulting in potential increase in offspring fitness may drive organisms to choose certain mates over the other. Three major hypotheses explain the mechanism of how MHC plays a role in sexual selection. The first is inbreeding avoidance. By selecting a mate with the most different MHC region regardless of the number of alleles, an organism can avoid mating with any animal even remotely related. The second hypothesis is maximizing MHC diversity. According to this hypothesis, an organism will try to choose a mate that has the most diversity, which will produce more resistant offspring to different parasites and infectious diseases due to their diverse MHC regions. The last is balancing selection. By choosing a mate that will result in the optimal number of alleles of the offspring, an organism can find a balance between maximum diversity and too much diversity that might result in outbreeding depression or local adaptation loss. We chose sailfin mollies, *Poecilia latipinna*, as the model organism to study the influence of MHC on sexual selection. We tested female mollies in a flow tank using two different male odor cues and recorded their preference based on the time she spent on each side of the tank.

Board 16

PAIGE RUPPEL AND BRITTANY LUTZ

Faculty Mentor: Amy Downing
Department of Zoology

Pond ecosystems are constantly faced with environmental pressures believed to decrease diversity. Ecologists are concerned that as diversity is lost in ecosystems, ecosystems may become more temporally variable and less predictable. In order to test this prediction, we constructed artificial, small-scale ponds in 300 L tanks and exposed them to various stresses including nutrient and insecticide pulses. Results suggest that indeed less diverse pond communities are more variable and less predictable.

EFFECTS OF ENVIRONMENTAL VARIABILITY ON STABILITY OF AQUATIC FOOD WEBS

Biodiversity in natural ecosystems is decreasing due to increased environmental disturbances and human interaction. Diversity may increase temporal stability of both populations and communities, although the relationship is not fully understood. We conducted an experiment in which we manipulated diversity in aquatic food webs within 300 L artificial pond communities. We exposed the artificial pond communities to a series of disturbances and examined the response of the zooplankton and phytoplankton communities in order to test if more diverse communities exhibit greater temporal stability in response to environmental variability. The disturbances, which included bi-weekly insecticide and nutrient pulses, were designed to mimic environmental variability due to human interaction. We sampled the tanks weekly over a twelve-week period to assess the temporal response of zooplankton and phytoplankton. Results indicate that more diverse communities exhibit greater temporal stability.

Board 17

CHARLES E. BRECHTEL

Faculty Mentor: Craig Jackson
Department of Mathematics and
Computer Science

Near the surface of a glacier, the air is at a lower temperature than that of the air further above the surface. This temperature difference leads to a pressure difference, that in turn leads to the higher pressure air pushing the colder air down the slope of the glacier. This process is continuous, and results in what is known as katabatic windflow. In my project we recorded data on the air velocity and temperature of the katabatic winds at varying heights above the Taku Glacier on the Juneau Icefield, and then model the behavior of the winds using a simple mathematical model.

MATHEMATICAL MODELING OF KATABATIC WINDFLOW ON THE TAKU GLACIER

Katabatic wind is a characteristic wind that can be observed on glaciers. The air closest to the surface of the glacier will be at a lower potential temperature relative to the surrounding air, and this creates a pressure differential. This pressure differential, along with gravitational forcing of the air down the slope of the glacier, produces the katabatic windflow. The Prandtl model uses the Navier-Stokes equations of fluid motion to develop a simple mathematical model of the behavior of air velocity and air temperature as a function of height above the glacial surface. Our project involves travelling to the Juneau Icefield in southeast Alaska to collect data on the behavior of the katabatic winds above the Taku Glacier. We deployed a 35-foot profile mast to measure wind and temperature variations above the glacier surface. We compare this data with profiles predicted by the Prandtl model and investigate the effect of including a synoptic forcing term into the model to better incorporate the potential surface effects of large-scale atmospheric motions.

ABIGAIL DOCKTER

Faculty Mentors: David Johnson
and Nancy Murray
Department of Botany-Microbiology

Members of the genus *Xylopia* are woody, tropical plants with a number of local uses. The strong, pepper-like flavor of the seeds and fruit made *Xylopia aethiopica* a trade item that found its way to the markets of Europe and was included in medieval herbals. Information from these herbals and from the notes on collected specimens was compiled to form a more complete picture of the many uses of *Xylopia* species.

ETHNOBOTANY OF *XYLOPIA*

The purpose of the summer's research was to summarize recorded knowledge of the human uses of *Xylopia*, a woody plant genus in the family Annonaceae with a pantropical distribution. Ethnobotanical data on the local names and uses of *Xylopia* were gathered from the labels of herbarium specimens. These data seemed to corroborate and add to the recorded uses published by previous authors. In Africa and tropical America, seeds and fruits of *Xylopia* species were sought after for their strong, pepper-like flavor, to be used in a popular condiment and as an ingredient for local medicines. Other parts of the plant were used for their structural and medicinal properties. On both continents, the wood was used for building houses and carving tools, the bark was used for tying purposes, and the leaves and bark were used in local remedies. There were no recorded uses for the roots of the plant. Although there are common *Xylopia* species in Southeast Asia, no recorded uses were discovered from this region.

Xylopia aethiopica was the most widely used African species, and in the Middle Ages it was traded to European markets as flavoring and medicine. This species, under several names, was included in medieval herbals. The entries often included a description of the plant and its uses, and sometimes were illustrated with woodcuts. Online digitized copies of these sources were examined for clues to European understanding of this useful plant. Medieval herbalists usually grouped *Xylopia aethiopica* in the genus *Piper* with the familiar spice, black pepper. They utilized information from previous sources, but because early accounts offer different names for the plant without detailed physical descriptions, subsequent herbalists disagreed on the earliest reference to this species.

Board 18

ALLISON KOLBE

Faculty Mentor: Tom Brutnell
Donald Danforth Plant Science Center, St. Louis, MO

The UN Food and Agriculture Organization estimates that food production will need to rise by 70% to meet global demand in the coming years. Optimizing photosynthesis to make plants use energy and resources more efficiently will be a powerful means to improve crop yield, especially in arid climates with limited resources. My research focused on understanding regulatory mechanisms which have allowed some plant species to evolve more efficient photosynthetic machinery.

EVOLUTION OF CARBONIC ANHYDRASE FOR C_4 PHOTOSYNTHESIS

As the world population climbs to 9 billion in the next 40 years, innovative plant breeding and genetic engineering techniques will be necessary to boost crop yield and meet the global demand for food, feed, and fuel. The C_4 photosynthetic pathway is an attractive target for genetic engineering because of its potential to boost crop yield as well as water and nitrogen use efficiencies. C_4 photosynthesis is characterized by carbon-concentrating mechanisms which maximize the concentration of CO_2 around the enzyme ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco). In order to maximize energy efficiency, C_4 plants have evolved specific anatomical adaptations which divide photosynthesis across two distinct cell types, mesophyll and bundle sheath cells, and restrict particular enzymes to each cell type. The enzyme carbonic anhydrase (CA) catalyzes the first reaction of C_4 photosynthesis, acting in the cytosol of mesophyll cells to convert CO_2 diffusing through the cell membrane into bicarbonate (HCO_{3^-}). The primary objective of my research was to characterize the structure and function of CA in *Setaria viridis*, a C_4 monocot. Setaria is a phylogenetically significant model system because it is closely related to several other C_4 grasses, including representatives from all three C_4 subtypes (NADP-ME, NAD-ME, and PCK). This provides a unique opportunity to examine the evolutionary history of C_4 photosynthesis. Thus, after characterizing CA in setaria, its structure was compared to CA genes in other C_3 (*Oryza sativa, Brachypodium distachyon, Dichanthelium oligosanthos*) and C_4 (*Zea mays* ssp. *mays, Sorghum bicolor*) species to identify regulatory mechanisms defining the role of CA in C_3 and C_4 photosynthesis.

Board 19

CAROLINE ROY

Faculty Mentor: Jun-ming Zhang
Department of Anesthesiology, University of Cincinnati

Chronic pain affects millions of people worldwide. This project aimed to use behavioral testing to quantify pain in a preclinical low back pain model in rats. Finding more ways to quantify pain in preclinical models will enable us to better understand and treat this condition in humans.

BEHAVIORAL ASSESSMENT OF PRECLINICAL LOW BACK PAIN MODEL

Reflexive measures are the current methods used for assessing pain levels of animals in preclinical pain models. This preclinical low back pain study used behavioral analysis as a novel method of pain testing. Grid walking and gait measurement were used to study the movement-evoked pain. Inflammatory pain was induced in rats through the inflammation of the L5 dorsal root ganglion (DRG), initiated by local application of the immune stimulator zymosan in incomplete Freund's adjuvant (Xie et. al. 2012). This resulted in a significant decrease in gait length, an increase in time to traverse and an increase in number of steps in the zymosan treated rats post operatively. Sham surgery rats showed no significant differences. In the zymosan treated rats one dose of naproxen (30 mg/kg) on post operative day 1 restored the number of steps taken back to baseline, however, there were no other significant differences seen. The same dose of naproxen showed no effects in preoperative animals or sham surgery rats. Further testing is needed to determine if grid walking and gait measurement will become a useful tool to measure pain in pre clinical models.

Board 20

BRADLEY TURNWALD

Faculty Mentor: Andreas Kulozik
University of Heidelberg Department of Pediatric Oncology, Hematology, and Immunology

Nonsense-mediated mRNA decay (NMD) is a cellular mechanism that can help eliminate potentially toxic shortened proteins. NMD plays a role in many genetic diseases like cystic fibrosis and muscular dystrophy so it would be clinically advantageous to develop treatments that can control NMD. Our results have demonstrated that Compound X seems to modulate NMD function in a human cell line, identifying it as a potential therapeutic treatment for NMD-associated diseases.

IDENTIFICATION AND EVALUATION OF A POTENTIALLY SPECIFIC INHIBITOR OF NONSENSE-MEDIATED DECAY

Nonsense-mediated mRNA decay (NMD) is an RNA surveillance system that targets transcripts with premature termination codons (PTCs) for rapid and specific elimination. This is an important process since PTC-bearing transcripts can encode proteins with potentially toxic effects. It is estimated that one-third of all inherited genetic disorders and some cancers are caused by mutations that introduce PTCs, and NMD plays a key role in the phenotype of many such diseases. It is therefore advantageous to investigate how controlling NMD efficiency might offer potential medical therapies for diseases like β-thalassemia, Duchenne muscular dystrophy, and cystic fibrosis. In this study we have identified one such compound, Compound X, that has a potential NMD-inhibitory effect. Using a cell-based chemiluminescence reporter system that recapitulates the hallmark features of mammalian NMD, an initial screen demonstrated that Compound X upregulates the PTC-bearing reporter protein. In further analysis by real time quantitative PCR, Compound X specifically upregulated a number of NMD target transcripts ranging from 1.5-fold to 9-fold compared with DMSO-treated control cells but had no effect on non-NMD targets. Time-course experiments suggested that Compound X has the most profound effects at 1.5 μM concentration and approximately 16 hours after administration. Compound X appears to have a pronounced NMD-inhibitory effect and further work will aim to uncover the mechanism by which Compound X inhibits NMD, the effect Compound X has on global translation, and the efficacy with which Compound X inhibits NMD in animal models of Duchenne muscular dystrophy.

Board 21

SAMANTHA EPLING

Faculty Mentor: Joel Warm
711th Human Performance Wing, Air Force Research Lab, Wright-Patterson Air Force Base, OH

Development of real-time, objective, and non-invasive measures of team coordination that predict team performance in fast-paced military operations (e.g., air traffic control, aircraft piloting, and group operations) is a priority in military research. This preliminary study emphasizes the superior sensitivity of Sample Entropy (a nonlinear metric that describes the degree of complexity/predictability in a time-series) over traditional measures of central tendency (e.g., mean, frequency, variance) for articulating team performance from observation of a non-invasive behavioral response (controller button press).

INTRA- AND INTERPERSONAL COORDINATION DYNAMICS ASSOCIATED WITH PERFORMANCE OUTCOMES IN A FAST-PACED PUZZLE TASK

Efficient and effective coordination is necessary for the success of fast-paced military team operations. However, surprising little is known about the properties of team coordination, how (or if) they relate to performance, and the ways in which team coordination is different (or similar) to that of individuals. The goal of this project was to address these issues by examining traditional and nonlinear indices of individual and team coordination in a fast-paced puzzle task and serves as a foundation for future research focused at forecasting team performance via objective and real-time coordination assessment. To accomplish this, same-sex dyads (teams) and individuals played a variant of video-game Tetris in three 20-min trials. For teams, one participant translated, while the other rotated, puzzle blocks. Individuals were responsible for both duties. Participants interfaced with the game using hand-held controls, which permitted the recording of button press timing and sequence (e.g., left, right, down, rotate). Results showed that traditional coordination measures (i.e., average time between button presses, total number of button presses, and variance of time between button presses) showed strong relationships with performance for individuals, but not for teams. Instead, high team performance was related to high sample entropy among the sequential sequence of button presses, indicating that a more complex (i.e., less predictable) temporal coordination was related to high team performance. Interestingly, the same relationship was found for individuals, hinting that the temporal coordination for individuals and teams were similar and that a 'flexible/dynamic' coordination strategy was optimal for performance in this task. Overall, these findings highlight the importance of examining nonlinear temporal dynamics in team coordination assessment. Future research has been planned to replicate these findings in a higher fidelity task environment (i.e., remotely piloted aircraft simulation).

Board 22

MICHELLE STORMS

Faculty Mentor: Gabriel N. Perdue
Department of Physics and Astronomy, University of Rochester

MINERvA is a relatively young collaboration at Fermilab with the goal of studying how a weakly-interacting particle called the neutrino reacts with various types of matter. Our research involved searching not for neutrino interactions, but rather for the decay of a yet-undiscovered particle into two muons. Although our research did not directly involve neutrino interactions, the work we produced is still of value to the collaboration as a whole. For example, we consolidated data concerning the detector's dimensions and created particle simulations which will be used by students and collaborators in MINERvA's scheduled 5-10 year run.

SEARCH FOR LONG-LIVED, WEAKLY-INTERACTING PARTICLE DECAYS TO OPPOSITE-SIGN DI-MUON PAIRS AT MINERvA

The Main Injector ExpeRiment for ν-A (MINERvA) is a neutrino-nucleus scattering experiment in the Neutrinos at the Main Injector (NuMI) beamline at Fermilab. The NuMI beam could, in addition to neutrinos, contain other long-lived, weakly-interacting, neutral particles. The MINERvA detector is sensitive to the charged particles (e.g. electrons, muons) that result from neutrino interactions and could reconstruct any such neutral particle decaying into a muon and an antimuon under certain kinematic constraints. This decay mode restricts the search to particles with mass greater than 212 MeV/c^2 and $c\tau \approx 1$ km. Theorists have speculated about the existence of a particle with these properties (Goh et. al. 2009), but such a particle has yet to be observed.

We required an original event generator to model particle decays upstream of the MINERvA detector, as opposed to the inner detector neutrino scattering events typically examined. A program specific to the MINERvA detector was developed to calculate geometrical acceptance as a function of the lifetime and energy of the incoming particle. These programs, as well as work done to consolidate information about the detector's position in space relative to the NuMI beam, will serve the collaboration in the future, regardless of the outcome of the search. A null result is expected, but our work allows us to set an upper limit on the hypothetical particle's production cross section. This allows dismissal or modification of theories predicting a particle with these properties.

Board 23

ALAN MASSOUH

Faculty Mentor: Herbert Dupont
University of Texas School of Public Health, Department of Infectious Disease

In addition to making poor dinner conversation, diarrheal diseases also comprise a significant challenge to healthcare the world over. The bacterium *Clostridium difficile* causes one of the deadliest of these diseases, and is commonly acquired in the hospital setting. Our research team is investigating the acquisition of *C. difficile* disease from contaminated hospital rooms, and attempting to discover patterns in the spread of the disease.

EVALUATION OF ENVIRONMENTAL CONTAMINATION BY *CLOSTRIDIUM DIFFICILE* IN HOSPITAL ROOMS AT ST. LUKE'S EPISCOPAL HOSPITAL, HOUSTON, TX

Reports of *Clostridium difficile* (CD)-associated diarrhea and colitis have increased markedly over the last decade, with evidence of major disruption of hospital activity and with substantial cost implications. The organism is a spore-forming bacillus that is capable of colonizing the gut, particularly among hospital patients that are old or otherwise immune-compromised, and have been given broad-spectrum antibiotics that eradicate the natural gut flora. With a rise in endemic CD infection, more serious disease is occurring, with increasing rates in younger, healthier patients. The spores of CD have been cultured from hospital rooms up to five months after having been occupied by an infected patient, and thus, contaminated environmental surfaces and healthcare personnel hand carriage are considered to be potentially important vectors for CD transmission in hospital. To investigate the frequency of environmental contamination and the molecular epidemiology of CD isolates from rooms and patients, extensive surface culturing was conducted in the room of every CD-infected patient at St. Luke's Episcopal Hospital (a tertiary care facility) over a 65-day period spanning June, July, and August of 2012. Samples from each room were obtained by sponge once weekly for three weeks, and were taken from numerous high-touch areas, including floors, light switches, bedrails, and others. PCR was used to positively identify environmental CD and numerous toxin genes associated with the organism. Strain identification by ribo-typing was conducted on environmental samples and patient stool samples. Preliminary data suggest that environmental contamination rates are substantially greater in rooms of infected patients compared to controls, though typing data are not yet available. Data collected in this study may be used for future investigations of the efficacy of current hospital cleaning practices.

Board 24

DEVINN SINNOTT

Faculty Mentor: Khrys Duddleston
Department of: Biological Sciences, University of Alaska Anchorage

Mammals have microbes in their gut that help with digestion, but these same microbes have been implicated in diseases, including obesity. Arctic Ground Squirrels are good organisms to study obesity with because they must gain an immense amount of weight before hibernation. This study aimed to characterize the gut microbes of Arctic Ground Squirrels by observing the effects of diet change and antibiotics on them. A change from a wild diet to a captive diet and the introduction of antibiotics caused changes in the diversity of microbes present in the gut of these squirrels.

THE EFFECTS OF DIET CHANGE AND ANTIBIOTICS ON THE DIVERSITY OF GUT MICROFLORA IN ARCTIC GROUND SQUIRRELS

Mammals have coevolved with their gut microflora (Ley et al. 2008) and developed a mutualistic relationship in which the host benefits from increased nutrient uptake and gut maturation while the microbes are provided with an anaerobic environment and access to nutrients (Falk et al. 1998). Although the relationship between mammalian hosts and their gut microbes is usually beneficial to both, gut microbes have been implicated in diseases, including inflammatory bowel disease (Gillevet et al. 2010), metabolic syndrome, and obesity (Bäckhed et al. 2004). The Arctic Ground Squirrel (*Urocitellus parryii*) is a promising organism for gut microbe-host interaction research because, as the northernmost hibernators in North America, they exhibit the most extreme hibernating physiology (Buck and Barnes, 1999b). During hibernation, they enter a ~9 month period of torpor (reduced body temperature, metabolic rate, and activity) interspersed with brief periods of euthermy. During their abbreviated (~3 month) active season, they must reproduce, grow, and fatten before re-entering hibernation. Pre-hibernation fattening occurs over a period of ~3 weeks in which they increase their body fat from 5% to >45%, making them a good model for studying obesity and gut microbes. Little is known about the gut microflora of hibernators, therefore descriptive studies of gut microbes are needed to understand this unique physiology. This study introduced an environmental change (shift in diet) in ground squirrel adults and a microbial disruption (antibiotics) in ground squirrel juveniles to see their effects on the gut microflora. A change in diet and the introduction of antibiotics both caused a shift in the level of diversity seen in the gut microbial community.

Board 25

KRISTIE GOUGHENOUR

Faculty Mentor: Herb Aldwinckle
Department of Plant Pathology and Plant-Microbe Biology, Cornell University

Fire blight is a devastating disease of apple crops caused by the bacterium *Erwinia amylovora*. My project evaluated different rootstocks for resistance to infection of the rootstock. Routes of rootstock infection were also investigated with infection of the scion, damage from borer insects and direct infection by contaminated rainwater considered.

INFECTION OF APPLE ROOTSTOCKS BY *ERWINIA AMYLOVORA*

Fire blight, caused by the bacterium *Erwinia amylovora* (Ea) is a significant threat to apple growers. Infection of the rootstock, usually leads to loss of the tree due to girdling of the rootstock. Susceptible rootstocks, and streptomycin-resistant strains of Ea, have led to an increased focus on breeding fire blight-resistant rootstocks. The route of infection of rootstocks was investigated, with infection of the scion, damage from borer insects and direct infection by contaminated rainwater considered as potential routes. The susceptibility of new and established rootstocks was investigated by inoculating the scions of young 'Gala' trees grafted on various rootstocks with Ea and observing rootstock infection. Another plot of trees simulated damage from borer insects carrying Ea. A third plot compared inoculation of blossoms, shoots, and rootstock shanks as modes of rootstock infection. Samples were collected, Ea was identified, and virulence of isolated strains was tested. Only 9 out of 20 rootstocks showed any rootstock infection and rootstock 70-06-08 appeared most susceptible with B-51-11, EMLA26, and EMLA9 also showing high susceptibility. Borer insect damage was a frequent route of rootstock infection. Blossom infection was the most common route of rootstock infection, although direct spraying of rootstock shanks with simulated contaminated rainwater did cause some infections. This indicates that contaminated rain could infect the rootstock, but probably only when the rootstock was damaged.

Board 26

JACQUELINE ROTH

Faculty Mentor: Audrey E. McGowin
Co-authors: Triet M. Truong and Kyle A. Danielson
Department of Chemistry, Wright State University

Fibropapillomatosis (FP) is a tumour-causing disease found in sea turtles. Leeches live on the turtles and are believed to transmit this disease. Since FP is found in turtles living in contaminated waters, contamination is believed to help spread the disease. Heavy metals were measured to determine the quality of the sea turtles' environments. The leeches were also used as samples of the turtles because they contained turtle blood.

HEAVY METAL ANALYSIS IN SEA TURTLE LEECHES (*OZOBRANCHUS* SPP.) USING ICP-OES

The purpose of this study is to quantify the amounts of trace metals found in sea turtle leeches (*Ozobranchus margoi* and *Ozobranchus branchiatus*) using inductively coupled plasma-optical emission spectroscopy. The ten metals measured are aluminum, arsenic, cadmium, chromium, copper, iron, manganese, nickel, lead, and zinc. Leeches were collected from various tropical locations and the Pacific and Atlantic ocean basins, including Barbados, Brazil, Florida, Hawaii, and Mexico. The findings of this study could be beneficial in the study of fibropapillomatosis (FP), which is a neoplastic disease affecting sea turtles. Many cases of FP have been found in contaminated waters, which allows for the possibility of environmental factors in the propagation of this disease. Additionally, fibropapilloma-associated turtle herpesvirus (FPTHV), the virus associated with FP, has been found in high concentrations in marine turtle leeches, and this study looks at the correlation between the trace metal concentrations and the presence of FP. Finally, this study investigates the potential use of marine leeches as biomonitors for endangered species, such as sea turtles since they inhabit the same space and feed on turtle blood.

Board 27

WEN YU (AMY) WONG

Faculty Mentor: Jonathan Keats
Translational Genomics Research Institute:
Integrated Cancer Genomics Division

Patients with Multiple Myeloma often die within 3-4 years after diagnosis. The current diagnostic tool is not sensitive enough to detect whether patients have leukemic cells during or after treatments. Therefore, my project has been to analyze Ig locus translocations as potential biomarkers to help develop a new assay that will be more sensitive, have a faster turnaround time, and distinguish which patients are at a higher risk for relapse.

DEVELOPING AN IMPROVED ASSAY FOR DIAGNOSING MULTIPLE MYELOMA AND MINIMAL RESIDUAL DISEASE: UTILIZING IG TRANSLOCATIONS

Multiple Myeloma (MM) is a malignant, monoclonal disorder of plasma cells that originates in the bone marrow and accounts for 1% of all cancers. Novel drugs, chemotherapy, and stem cell transplantation, has improved the outcome of MM patients and many have achieved complete response (CR). CR is defined by rudimentary measurements and there is a need for minimal residual disease (MRD) tests. MRD tests detect the small number of leukemic cells that remain in patients during or after treatment. Clinically, serum electrophoresis is used both to diagnose MM and predict relapse since the monoclonal gammopathy creates a predictably large spike in the gel where all the immunoglobulins migrate. However, serum electrophoresis is not a reliable diagnostic tool and an improved approach is needed. The goal of this project is to develop a clinical assay that is more sensitive, is useful for any B cell malignancies, and detects MRD. The translocations of the Ig locus are common events in B cell malignancies and we hope to use these regions as biological markers. Twelve positive controls were found by scanning our MM cell lines for Ig translocations – VDJ, DJ, kappa, and lambda recombinations by performing PCR, gel electrophoresis, and sending the samples for Sanger sequencing. For each recombination, the junction sequence, mutation rate, and the gene expression are known. Up to eight different biological markers are noted for each positive control to help create an assay that will detect monoclonality and MRD. Future wok for this project involves developing the actual assay along with a bioinformatics program to analyze the data. The long-term goal of this project is to create a better clinical diagnostic tool, have a faster turn around time, and provide a superior assay to distinguish patients with high, intermediate, and low risk of relapse by using biological markers.

Board 28

T.J. CLARK

Faculty Mentor: Edward P. Levri
Department of Biology, Penn State - Altoona

The New Zealand mud snail is a rapidly spreading invasive species in the USA composed of at least three different asexual clones with different invasive potentials. Our research was conducted to understand the differences in behavior due to genetics among the invasive and non-invasive clones of snails. We hope that recognizing the differences in behavior may help to explain why some clones are more invasive than others and possibly to alleviate the problem of the invasiveness in the snails to our freshwater ecosystems.

EFFECT OF GENOTYPE ON GEOTACTIC AND PHOTOKINETIC BEHAVIORS IN AN INVASIVE FRESHWATER SNAIL

Behavior in animals has a genetic component. In the New Zealand mud snail (*Potamopyrgus antipodarum*), behavior has been shown to be influenced by both light and gravity. The snail exhibits positive geotaxis (moves down) and positive photokinesis (moves faster in light than in dark). The present study investigated differences in behavior between different asexual clones of this species and compared invasive and non-invasive clones of snails with respect to geotactic and photokinetic behaviors. There was evidence that there was a significant difference in behaviors between clone types in the snails in response to light and gravity. Interestingly, the most invasive clone behaved most differently from the other clones. These results indicate that there is a genotypic effect on behaviors in this freshwater snail, and this may help us to comprehend the invasive qualities of the snail.

Board 29

NURUL TAIMUR ISLAM

Faculty Mentor: Yong P. Chen
Department of Physics, Purdue University

Graphene, a very thin layer of graphite (roughly a millionth times smaller than thickness of a human hair), has exceptional electronic and thermal capabilities. However, its small thickness prevents measurements of its fundamental physical properties using currently available laboratory techniques and apparatus. Thus, one has to rely on molecular dynamics, which is a computer simulation technique that calculates the positions, and velocities of a set of interacting atoms based on Newton's laws of motion. This computational method allows accurate determination of these fundamental quantities. In our research, we used molecular dynamics to study the melting temperature, and thermal conductivity of a very small graphene system.

A MOLECULAR DYNAMICS STUDY OF THERMAL TRANSPORT AND MELTING OF GRAPHENE NANOSTRUCTURES.

We studied the melting and thermal conductivity of graphene using molecular dynamics simulation, which is a computer simulation technique that determines the time evolution of a set of interacting atoms. Using Adaptive Interatomic Reactive Empirical Bond Order (AIREBO) to mimic the potential between carbon atoms, we determined the melting temperature of a 324-atom graphene layer to be approximately 4200K. In addition, we discovered that a single-atom defect reduced the melting temperature of the graphene lattice. Furthermore, we studied thermal conductivity of graphene using a transient heat conduction method. By calculating the thermal diffusivity from 1D transient heat conduction, and determining the specific heat of graphene, we were able to calculate the thermal conductivity of graphene.

Board 30

MEGAN COOK

Faculty Mentor: Abbie McCauley
Director of the Family Child Learning Center's Integrated Research Preschool

The long-term outcomes for children with autism spectrum disorders (ASD) are highly dependent on their communication skills by age 5, so it is important to find ways to measure language at an early age and to ensure that therapies are successful. The FCLC integrated preschool is the first to measure preschoolers with ASD and their typically-developing classmates throughout the school year using Language Environment Analysis software. We found that children with ASD speak and interact more in school than at home, especially when they receive one-on-one attention and when teachers follow the child's lead, instead of making the child follow specific directions. Regardless of their diagnosis, all children received the same attention from teachers, and both groups showed improvement in how much they spoke and had conversations over the course of the school year.

AUTOMATED ANALYSIS OF THE INTEGRATED PRESCHOOL AND HOME LANGUAGE LEARNING ENVIRONMENTS OF CHILDREN WITH AUTISM

Biweekly recordings of nine children with autism spectrum disorder (ASD) and eight typically developing (TD) peers in two integrated preschool classrooms were collected in three settings (home, ASD-only days, and integrated "peer days") throughout the school year. The automated Language Environment Analysis (LENA) system was used to collect counts of adult words (AWC), child vocalizations (CVC), and conversational turns (CTC) and measures of meaningful speech and conversational interactions. Rather than detecting between-group differences based on diagnosis, LENA data showed trends towards significance in within-group improvements CVC and CTC throughout the year. The interaction term was not significant for any variable, indicating similar treatment effects and trajectories for the ASD and TD groups, though the TD group showed less inter-child variance. In accordance with a developmental, social-pragmatic model, AWC and CVC were significantly negatively correlated across all classroom activities, indicating a responsive teaching style. CVC increased significantly over time in both child- and adult-directed activities, but child-directed activities showed a greater increase and a higher rate of vocalizations for both groups. Preliminary findings indicate that AWC, CVC, and CTC for the ASD group are higher on days the peers are not present; the children monologue less, and converse more with adults but less with other children. Compared to the language-rich preschool environment, at home children with ASD hear fewer adult words and vocalize and converse less; a higher proportion of their vocalizations are monologues. Sibling studies indicate meaningful speech in the home increases when a female child is present, but is lower in homes of children with ASD. For future research, LENA will serve as an objective measure of the success of parent-focused language interventions.

Board 31

JENNA E. REEGER

Faculty Mentor: Kevin D. Walker
Department of Chemistry and Department of Molecular Biology,
Michigan State University

A family of enzymes, phenylalanine aminomutases, can be used to make precursors to pharmaceuticals. Two of these enzymes, *Tc*PAM and *Pa*PAM, both react with (2*S*)-α-phenylalanine, but *Tc*PAM converts it to (3*R*)-β-phenylalanine, while *Pa*PAM converts it to the opposite product, (3*S*)-β-phenylalanine. The structure of *Pa*PAM was analyzed to understand how and why it makes a similar yet opposite product to *Tc*PAM. Understanding more about these enzymes will potentially lead to their use in industry as biocatalysts.

BIOCATALYTIC COMPARISON OF A BACTERIAL AMINOMUTASE WITH AN ISOZYMIC PLANT-DERIVED AMINOMUTASE

A phenylalanine aminomutase produced by *Pantoea agglomerans* bacteria (*Pa*PAM) acts as a catalyst in the first step of the biosynthetic production of the antibiotic, andrimid. *Pa*PAM catalyzes the conversion of (2*S*)-α-phenylalanine to (3*S*)-β-phenylalanine. A related phenylalanine aminomutase from *Taxus canadensis*, (*Tc*PAM), catalyzes a similar reaction but produces (3*R*)-β-phenylalanine from (2*S*)-α-phenylalanine. The results from these previous studies led to further investigation of the structural divergences between the enzymes *Pa*PAM and *Tc*PAM that are responsible for producing their stereospecific products. This study used point mutations within the *Pa*PAM active site that were guided by the *Pa*PAM structure and changed to analogously positioned yet different active site residues with *Tc*PAM. By understanding the mechanistically important residues in *Pa*PAM, its structure can be manipulated to optimize the catalytic efficiency of the biocatalyst.

Board 32

CHRISTIAN KISSIG

Faculty Mentor: John P. Wolfe
Department of Chemistry, University of Michigan

Oftentimes, nature has lent us a hand in the quest for innovative drugs. Natural products are chemical compounds produced by living creatures that elicit beneficial biological effects. A group of molecules called isoxazolidines comprise some natural products and display promising effects in combating a multitude of diseases including cancer, retroviruses, depression, and bacterial and fungal infections. This particular project was aimed at developing a method of selectively creating this structural class.

ENANTIOSELECTIVE SYNTHESIS OF ISOXAZOLIDINES: EFFECTIVE SYNTHETIC INTERMEDIATES AND VITAL COMPONENTS OF PHARMACEUTICALS

The enantioselective synthesis of isoxazolidines via palladium-catalyzed carboetherification of N-butenyl hydroxylamines has been examined with a variety of chiral phosphine ligands. The substrates were afforded in three steps via butenylation of benzylamine, benzoylation, and esterification. These experiments have led to significant progress towards the development of a new method for the preparation of a class of molecules that have previously demonstrated an array of interesting biological properties. Additionally, this work provides a facile route for the assembly of 1,3-amino alcohols, which are important synthetic intermediates.

The NSF-funded REU/RET (Research Experience for Undergraduates/Teachers) program at Ohio Wesleyan makes it possible for 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 33

RICHARD SCOTTEN,
FULLERTON COLLEGE

Faculty Mentor: Robert Haring-Kaye
Department of Physics and Astronomy

An exciting frontier of nuclear physics research explores how an atom's nuclear structure changes when it is overloaded with neutrons. Our research examines the nucleus of oxygen-24, an isotope containing sixteen neutrons – twice the number of neutrons as oxygen found in nature, and the maximum number an oxygen nucleus can contain without spontaneously ejecting a neutron. These studies help us understand how atoms are forged in astrophysical reactions, as well as expand our fundamental knowledge of the nuclear architecture.

COMPOSITION OF THE ^{24}O GROUND STATE WAVE FUNCTION

Our understanding of the atomic nucleus is represented by the nuclear shell model, which was derived primarily from a set of stable (or near-stable) nuclei – the easiest to study in a laboratory. Yet, recent experimental and theoretical studies have shown that the model needs refinement for isotopes with an overabundance of neutrons. In these cases, the discrete energy states a neutron can occupy shift for the valence neutrons, as the strong nuclear force is sensitive to the number of neutrons (N). For example, when $N = 16$ in neutron-rich ^{24}O, shifting valence states lead to an especially energetically favorable configuration of neutrons, indicating a new "magic number" (closed shell of neutron states) that is absent in the stable counterparts. This research seeks to test just how "magic" ^{24}O is by measuring the composition of the ^{24}O ground-state wave function, the mathematical construct that describes how nucleons arrange themselves. This will be done in part by measuring the probability that stripping off a neutron from ^{24}O leaves the resulting ^{23}O nucleus in its ground state or first-excited state (which immediately decays to ^{22}O through neutron emission).

An experiment was conducted recently at the National Superconducting Cyclotron Laboratory at Michigan State University to produce ^{24}O. Before the physics can be gleaned from this experiment, the raw data required a series of offline calibrations. Our work involved calibrating an array of 144 neutron detectors called MoNA (Modular Neutron Array). These included the timing and position calibrations necessary to measure the momentum, dispersive angle, and total energy of a neutron resulting from the decay of the first-excited state of ^{23}O. By combining these neutron measurements with the equivalent measurements for the charged particles, we can take the first step towards understanding the composition of the ^{24}O ground state wave function.

Board 34

ZIJIE POH,
OHIO WESLEYAN UNIVERSITY

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

SYNCHRONIZATION OF COUPLED JOSEPHSON JUNCTIONS

We study numerically and analytically the phase dynamics of coupled Josephson junctions (JJs) of two plaquettes in parallel (shunted) by a third junction. A plaquette is a square with a junction at each side. This geometry is motivated by single crystal Bismuth Strontium Calcium Copper Oxide (BSCCO), a layered high-temperature superconductor consisting of hundred or thousands of intrinsic Josephoson junctions (IJJs). We look for evidence of both frequency and phase synchronization in the dynamic (oscillating) junctions of the plaquettes. Frequency synchronization is attained when the phase difference of the junctions is independent of time. Phase synchronization is attained when the phase difference of the junctions is zero. We find numerical evidence that intra-plaquette synchronization can be obtained even with weak coupling between the junctions in a plaquette and without the shunted junction. However, the shunted junction is crucial for synchronization between the junctions in neighboring plaquettes (inter-plaquette synchronization). Analytically, we use perturbation theory and a multiple time-scale analysis to predict the combinations of junction parameters for which phase synchronization appears in the array. We successfully capture the intra-plaquette synchronization behavior. The analytic study of inter-plaquette synchronization is still in progress.

Board 35

RYAN AVRIL, WESTMINSTER COLLEGE AND ERICK ROSSI DE LA FUENTE, CENTRAL PIEDMONT COMMUNITY COLLEGE

Faculty Mentor: Bob Harmon
Department of Physics and Astronomy

STELLAR SURFACE IMAGING

Starspots are dark spots on the surface of a star caused by magnetic fields piercing the plasma in the photosphere (visible surface) of the star. The magnetic field lines interact in such a way that convection is suppressed, thus inhibiting the upward transfer of energy into the spot from below. Because the transfer of energy is inhibited, the spot becomes cooler and thus appears darker than the surrounding photosphere. For this project, we observed LO Pegasi, a K8 main-sequence star approximately 82 light years away, in order to study the evolution of its starspots. This was done by comparing the CCD camera digital images of a star field containing LO Pegasi were obtained through standard B, V, R, and I photometric filters at Perkins Observatory. Differential aperture photometry was used to compare the brightness of LO Pegasi to SAO 89758, which is a star of constant brightness. In this way we produced light curves, i.e. plots of brightness versus time. These light curves were then give as input into a light curve inversion algorithm which produces images of the stellar surface based on the brightness variations caused by the dark spots rotating into and out of view of Earth. Images for data obtained from 2006-2012 indicate that a polar spot is prevalent on LO Pegasi and is larger in 2012 than in any of the prior years, suggesting that the star has become more magnetically active.

Board 36

JEANETTE VELDMAN, CENTRAL COLLEGE

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

A STUDY OF SYNCHRONIZATION OF JOSEPHSON JUNCTIONS

The arrangement of two superconductors separated by a micron-sized nonsuperconducting barrier is called a Josephson Junction (JJ). In addition to properties such as resistance and capacitance, every JJ is described by is critical current, which is the maximum current the JJ can sustain without a voltage drop across the junction. When a JJ is biased with a current greater than its critical current, a voltage drop across the JJ appears and the JJ emits microwaves with power measurable in nanowatts. We perform a combination of numerical simulations and analytical approximations, based on a well-established model of JJ behavior, to search for evidence of synchronous voltage oscillations in *arrays* of JJs in three geometries: a square with one JJ one each side; two squares of JJs that share a common side; and a serial connections of two JJs. An order parameter, which quantifies the degree of synchronous oscillations in the array, is calculated for all three geometries as a function of such parameters as: bias current, junction capacitance, and junction critical current. For each of the three geometries, our goal is to find the optimal combination of junction parameters such that the largest possible subset of JJs in the array oscillates synchronously. Such an array could consequently emit microwaves with power in the microwatt range or higher.

MATTHEW HUGHES,
BARD COLLEGE AND
ELDEN ELMANTO,
UNIVERSITY OF CHICAGO

Faculty Mentor: Craig Jackson
Department of Mathematics and
Computer Science

HOMOLOGICAL AND QUANTUM REPRESENTATIONS OF THE BRAID GROUPS

In 2001, Stephen Bigelow showed that the braid groups B_n are linear by finding a faithful representation of B_n on the second homology module $H_2(\tilde{C}_{n,2})$. The space $\tilde{C}_{n,2}$ is constructed as a regular covering space of the configuration space $\tilde{C}_{n,2}$ of all unordered pairs of distinct points in an n-punctured disk and the braid generators act on this space as Dehn twists. This seminal paper, along with Daan Krammer's article in which he independently proved the same result, lead to renewed interest in braid group representations. However, the braid representations arising from the full family of homology modules $H_\ell(\tilde{C}_{n,\ell})$ $(\ell>2)$ have remained mostly unexplored. Recently, Jackson and Kerler have demonstrated that the homological braid representation on $H_2(\tilde{C}_{n,2})$ is isomorphic to the representation of B_n arising from the action of a universal R-matrix on a highest weight space $W_{n,2}$ of the generic Verma module $V^{\otimes n}$ of the quantum group $U_q(\mathfrak{sl}_2)$. They further conjecture that $H_\ell(\tilde{C}_{n,\ell})$ is isomorphic to $W_{n,\ell}$ for all $\ell \geq 0$. This result provides an intriguing connection between the homological representations of Bigelow and others and the vast families of braid group representations constructed from quantum algebras and conformal field theories. In this project, we have extended Jackson and Kerler's result to the case $\ell = 3$. This requires a generalization of Krammer and Bigelow's geometric notion of "forks" to 3-forks, thereby providing a geometric way to calculate the action of B_n on $H_3(\tilde{C}_{n,3})$. We then identify a basis of $H_3(\tilde{C}_{n,3})$ which, after identification of certain parameters in the ground ring, give matrices for the homology representation that are identical to those obtained from $W_{n,3}$. We have also shown that, unlike the case $\ell = 2$, the representations on $H_3(\tilde{C}_{n,3})$ does not correspond to any irreducible representations arising from the Birman-Murakami-Wenzl (BMW) algebras. We further hope to generalize the notion of forks to ℓ-forks for an arbitrary positive integer ℓ and establish an inductive framework to settle the conjecture for $\ell > 3$. Furthermore, we seek a geometric interpretation of a particular decomposition of the highest weight spaces given in arising from a restriction of the braid action.

KIRA GOLDNER,
OBERLIN COLLEGE

Faculty Mentor: Sean McCullich
Department of Mathematics and
Computer Science

DIFFERENT OPTIMAL SOLUTIONS IN SHARED PATH GRAPHS

We examine an expansion upon the basic shortest path in graphs problem. We allow journeys—source-destination pairs—in weighted and connected graphs to equally split the cost of shared edges. In this new problem, there are multiple possible definitions of optimal. We investigate three: minimizing the total resources—the sum of the journeys' costs—of a graph; minimizing individual journeys' costs with analysis from game theory with an aim of stable formations; and minimizing the maximum cost that any journey in a graph has to pay. We developed heuristics that, given any weighted, connected graph and a set of journeys, can manipulate the journeys into routes that approach these definitions of optimal. Two versions, speedy and exhaustive, were developed of the same game theory heuristic. Tests are being done to compare how often the speedy version is equally as effective as the exhaustive version. Pre-existing heuristics are also being studied to determine which are closest to these various definitions of optimal.

COREY SMITH,
WINONA STATE UNIVERSITY

Faculty Mentor: Scott Linder
Department of Mathematics and
Computer Science

INFERENCE FOR CORRELATION IN A BIVARIATE NORMAL MODEL SUBJECTED TO TYPE II CENSORING

Suppose a random sample of n bivariate normal variates is subjected to Type II censoring on one of the variates, so that only those associated with p of the order statistics and their concomitants are observed. We demonstrate that Fisher's Z transformation, widely used for inference about the correlation coefficient, performs poorly in this setting, especially when censoring is moderate or severe or when the population correlation is far from zero. Using simulation and modeling, we propose a modification to the tail percentiles of the approximating sampling distribution induced by Fisher's Z transformation. This modification depends upon experimental conditions, n and p and the observed sample correlation. Using simulation, we demonstrate that use of this modifier results in improved tail percentile estimates, which leads to greatly improved inference for population correlation.

Graduation with Departmental Honors requires an independent project, an oral exam on the project, and a comprehensive exam in the student's major department during his or her senior year. The program is open to students who have attained cumulative grade point averages of 3.5 in their majors after fall semester of the 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 Ohio Wesleyan Academic Policy Committee.

Student Name	Department	Supervising Professor	Title
Celia Baker	History	Flamm	Breaking The Ice: Ronald Reagan, Star Wars, and The End Of The Cold War
Kale Booher	History	Spall	The Power of the Word: The Preeminence of Scripture in The Political Thought of Martin Luther
Mallory Friebis	Psychology	Leavy	Factors that Influence the Effort Guidance Counselors Put Into Writing Letters of Recommendation for Students
Kellie Gross	Neuroscience	Yates	Preventing Post-traumatic Stress Disorder: A Pharmacological Approach
Andrea Hatfield	Psychology	Leavy	The Cognitive, Physiological, and Affective Effects of Natural Environments
Alexandra Hutchings	Women's & Gender	Schrock (FS) / Richards (SS)	The Corset Experience: A Twenty-First Century Woman's Experience With A Nineteenth Century Garment
Zeal Jagannatha	Computer Science	Zaring	An Object-Oriented Circuit Simulation Library
Hairong Jiang	Psychology	Smith	The Effect of Intergoup Threat on People's Discriminatory Behaviors: Ingroup Favoritism or Outgroup Derogation?
Alyse Marotta	Physical Education	Fink	An Action Research Project Describing Food Education Programming Designed to Support Increased Personal Health and Health of the Food System
Ann Merrell	International Studies	Gingerich	The Age of Imperialism: The Legacy of the Colonization of the Congo
Timothy Prindle	Geography	Krygier	The Women's Temperance Crusade in Delaware, Ohio: Gender and Power in a City Divided
Amit Roy	Computer Science	Zaring	Solution Selection via Neural Network
Cailee Smith	Zoology	Hankison	Intraspecific Variation in the Gonopodial Morphology of the Yucatan Sailfin Moly, *Poecilia velifera*
Bennett Thompson	Chemistry	Lance	Synthesis of a Diamine-Diamide Macrocycle for the Stabilization of High-Valent Iron Complexes
Abigail Walsh	Physical Education	Fink	An Examination of Exercise Programming in Crohn's Disease: A Salutogenic Approach
Caitlin Zeller	Fine Arts	Cetlin	Plants with Attitude

Here are some of the things past SSRP participants are doing now.

2010 SSRP PARTICIPANTS

LAURA BOWES, '12

Attending the Cabell-Huntington Hospital's School of Cytotechnology for one year in Huntington, WV, to become a licensed cytotechnologist

HENGZHI CHEN, '12

Beginning graduate school at the University of Michigan for Electrical Engineering

NASIE CONSTANTINO, '12

Beginning graduate school Texas A&M University in plant pathology or biofuels

KELLIE GROSS, '12

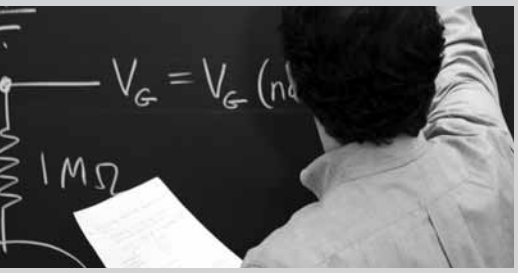
Attending the University of Minnesota to study Neuroscience

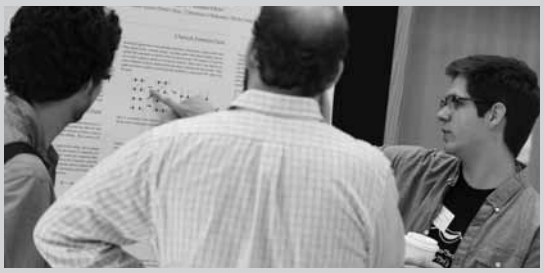
SHARIF KRONEMER, '12

Beginning graduate school at University College London (UCL) in their MSc program in Cognitive Neuroscience

IFTEKHAR SHOWPNIL, '13

Received a grant from the American Society of Plant Biologists to complete his research at OWU this summer






2011 SSRP PARTICIPANTS

HAO DO, '12

Traveling in India, Malaysia, and finally coming back to his hometown in Vietnam. This fall, beginning graduate school at Boston College studying Economics

JACOB DODD, '12

Applying to medical school for fall 2013. Plans to work as a research assistant or associate in a neurosurgery lab for the next year.

ZEAL JAGANNATHA, '12

Working at a summer internship in Mountain View, CA for a startup called Skybox Imaging

EMILY KIOURTSIS, '12

Beginning graduate school this fall at Wright State University's School of Professional Psychology to obtain her PsyD in Clinical Psychology

ALAN MASSOUH, '13

Working in Dr. Herbert DuPont's lab at Baylor College of Medicine doing research on traveler's diarrhea; more specifically, *Clostridium difficile* infections and treatments and variations in human response to the disease.

BHAVNA MURALI, '12

Attending Washington University in St. Louis to study Molecular Cell Biology

ZIJIE POH, '13

Continue his research project at OWU with Brad Trees

KRISTIN SCHWACHA, '13

Received a Theory-into-Practice Grant to continue her research project from last summer in Tami Panhuis' lab

BRAD TURNWALD, '13

Recipient of a Theory-into-Practice grant to do a 10-week research project in Heidelberg, Germany, at the Molecular Medicine Partnership Unit, which is a joint research facility for the The University of Heidelberg Medical School and European Molecular Biology Laboratories (EMBL). His research will involve the RNA surveillance system known as nonsense-mediated mRNA decay (NMD). Will return to OWU for his senior year and apply to MD/PhD programs.

CAMPUS AND OFF-CAMPUS RESEARCHERS

NSF-REU/RET RESEARCHERS

SPECIAL THANKS

Rock Jones
David Robbins
Charles L. Stinemetz
Karen McNeal
Laurie Patton
Barbara Andereck
Ohio Wesleyan University Buildings and Grounds Staff
OWU/Aramark Housekeeping staff
Chartwells Dining Services
Office of Marketing and Communications
Faculty supervisors and student volunteers
Parents and guardians of student researchers

THE OPPOSITE OF ORDINARY

Ohio Wesleyan University • 61 South Sandusky Street • Delaware, Ohio 43015