Ohio Wesleyan University

RESEARCH SYMPOSIUM

Patricia Belt Conrades
Summer Science Research Symposium »

September 15, 2008

Rock Jones >>

President of Ohio Wesleyan University

"The Summer Science Research Program at Ohio Wesleyan University is one of the nation's premier programs for undergraduate research in the sciences. The quality of the research is reflected in the fact that many student participants are invited to present their results at national conferences, and some have their results published in highly regarded journals. These programs set OWU as a leader among liberal arts institutions in undergraduate education in the sciences and allow students to complement their work during the academic year with focused, independent research that prepares them well for graduate school and careers in science. I enjoyed my visit with students in their labs this summer and the opportunity to hear some of the students discuss their work. I was impressed by the quality of the research, the students' passion for science, and their ability to articulate their research questions, methodologies, and emerging results."

The Patricia Belt Conrades Summer Science Research Symposium

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

Now in its 16th year at Ohio Wesleyan, the Patricia Belt Conrades Summer Science Symposium encourages engaged research and learning within a 10-week period. This culminates in a symposium allowing students to proudly present their research in poster format at a gala event in the atrium of our Conrades•Wetherell Science Center.

Contents >>

Atrium, Conrades•Wetherell Science Center

Monday, September 15, 2008 at noon

Opening remarks by President Rock Jones followed by student poster presentations at 12:10 p.m.

Thoughts from the Director

Ohio Wesleyan is an institution that strives to meld classroom knowledge with practical experiences. The Summer Science Research Program does just that.

There is no better way to learn how to be a scientist than through the doing of science. In science classes this is often accomplished in the accompanying laboratory. However, experience in student research goes beyond the class laboratory experience by empowering students to take control of their learning. Student participation in the Summer Science Research Program goes a step beyond research conducted during the normal academic year by totally immersing students in the research experience. This immersion allows students to focus and hone their intellectual skills through investigating questions of import to not only their research group but the wider national and international academic community. With careful guidance from our science faculty, the students in this program have had that unique experience of possessing a piece of new knowledge prior to adding it to the greater body of scientific understanding. Today is a very proud day for the students who conducted research, their faculty mentors, and our institution as we celebrate the work of these students during today's Patricia Belt Conrades symposium. We are deeply grateful to Dr. Nancy Schneider '64 for providing the endowed funds for this community celebration of our science student successes.

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

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

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

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

Chuck Stinemetz
Summer Science Research Program Director
Dean of Academic Affairs

The Making of a Scientist

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

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

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

During the Symposium this afternoon, you will have the opportunity to interact with 20 students who performed research at OWU this summer mentored by OWU faculty members, 5 students from universities other than OWU who worked on campus with OWU faculty, and 19 OWU students who performed research off-campus at other universities or in other countries. There is no doubt that the research results presented here today are exciting and novel. However, equally as exciting is the opportunity for you to speak with and interact with these 44 young scientists.

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 Events Coordinator

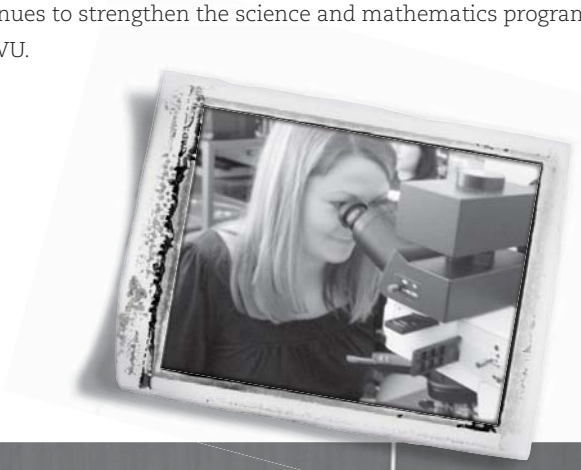
The Patricia Belt Conrades Summer Science Research Symposium Endowment

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 Mt. 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 is also a member of Ohio Wesleyan’s 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.

Britta Buchenroth ’09 explains her research to Patsy Conrades and Nancy Schneider.



Provost David Robbins, Summer Science Research Program Events Coordinator Laura Tuhela-Reuning, Dr. Nancy Reynolds Schneider ’64, Patricia Belt Conrades ’63, and Dean of Academic Affairs Chuck Stinemetz ’83 at the 2007 Summer Science Research Symposium.

Board 1

Caitlin Willet and Valerie Sloboda

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

Tip of the Tongue is the expectation that recall is imminent for information that is momentarily not recalled. Feeling of Knowing refers to the judgment that one could identify on a multiple choice test memory content that is not recalled. This study investigated whether these two concepts are functionally equivalent by comparing the accuracy of partial knowledge of the answer (first letter and number of letters) for TOT and FOK judgments. If these terms are found to be functionally equivalent in predicting partial knowledge accuracy, a common term should be substituted for both of them.

Tip of the Tongue and Feeling of Knowing: Are They Functionally Equivalent?

Failure to access information is a frustrating experience, particularly when we feel strongly that we have the information in memory. This ability to judge information in memory is an aspect of metacognition, or our awareness of our own cognitive systems and knowledge (Ashcraft, 1998). Tip-of-the-Tongue (TOT) and Feeling of Knowing (FOK) are metacognitive judgments about our ability to recall or recognize currently inaccessible information. TOT is the feeling of certainty that one knows some piece of information and that recall is imminent. FOK refers to a level of confidence that one has enough knowledge to recognize the target information from a list of choices. These two metacognitive judgments are typically studied as separate phenomena, but our prior research suggests that these concepts refer to the same metacognitive processes. We found that TOT and FOK judgments predict subsequent recall and recognition with comparable accuracy. The goal of this study was to determine if TOT and FOK similarly predict other information about memory, specifically can participants in TOT and FOK states access partial knowledge of the target.

Forty-three college students were given 224 questions about general knowledge and famous people. If participants failed to recall the answer they were asked to give either a TOT or FOK judgment. TOT judgments were given in a yes or no format; FOK judgments were made on a scale from 1 (certainly no) to 6 (certainly yes). The participants were then asked to guess the first letter of the word they could not recall, and the number of letters in that word.

Analysis of results will compare the accuracy of TOT and FOK based guesses of the first letter and number of letters. If TOT and FOK judgments predict partial knowledge of the unrecalled targets with comparable accuracy, these results will provide additional support that TOT and FOK are functionally equivalent.

Board 2

Megan Evans

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

Our research focuses on how plants integrate gravity signals to influence their growth and development. We used real-time computer image analysis to uncover the mechanisms driving differential growth in plants. The growth of an *Arabidopsis* mutant that plays a role in the transport of auxin, a plant hormone playing a role in growth regulation, was quantified.

Altered Growth Response of *pin3* in *Arabidopsis thaliana*

Arabidopsis thaliana responds to gravity through downwards root growth, in an attempt to achieve parallel orientation of the primary root with the gravity vector. The Cholodny-Went Theory suggests that an asymmetrical concentration of auxin, a plant hormone playing a role in growth regulation, contributes to differential growth. The redistribution of auxin is regulated by various auxin influx and efflux facilitators. The *Arabidopsis gene PIN3*, which encodes an auxin efflux carrier from the PIN family of proteins, is involved in auxin transport at the root apex. PIN3 is expressed in the gravity-sensing cells of the root columella. PIN3 is positioned symmetrically and rapidly accumulates laterally upon gravistimulation. Lateral relocation of PIN3 is predicted to increase auxin transport toward the lower flank of the root cap and facilitate an asymmetrical auxin concentration. We used image analysis software to quantify the gravity response of *pin3* mutants. We found that *pin3* mutants showed a diminished gravity response. We also used a feedback system to maintain the root tip at a given angle to gravity to provide a constant gravitropic stimulus while curvature development was tracked over time. We found that *pin3* mutants did not show a dose-dependent response with the root tip constrained at 30° and 60°, but demonstrated a slight increase in curvature when the tip was constrained at 90°.

Board 3

Rachel Decker

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

We present images of starspots on the surface of the star LO Pegasi obtained by analyzing changes in the star's brightness on digital images we acquired at Perkins Observatory in June and July of 2008 and compare them to results from previous years. Starspots are areas on a star which are cooler and thus darker than the rest of its surface. Like sunspots on the Sun, starspots are regions where the magnetic field is thousands of times stronger than average. By studying starspots, astronomers gain insight into the mechanisms by which magnetic fields are generated on the Sun and other stars.

Stellar Surface Imaging of LO Pegasi

The purpose of this study was to image the surface of the star LO Pegasi in order to study its starspots. Starspots are large, dark spots on the surface of a star caused by bundles of magnetic fields which protrude through the surface and suppress the flow of heat by convection, thereby causing parts of the surface to cool. Understanding how starspots are formed and move on the surface of the star can give us a greater understanding of the magnetic behavior of this star and more insight into how our own Sun behaves.

It is impossible to actually resolve the surfaces of stars because they are so far away, so we must use indirect methods of imaging the star's surface. We took hundreds of telescopic digital images throughout several nights in June and July of 2008 through B, V, R, and I photometric filters and performed aperture photometry on them. We then performed aperture photometry to measure and record the fluctuations in brightness of the star as the dark spots on its surface rotated into and out of our field of view. These variations are manifested as dips in a plot of brightness vs. phase (the fraction of the rotation the star has turned through), which is called a light curve.

These data were then fed into an algorithm called Light-curve Inversion that reproduced an image of the star's surface showing where the spots are located. We compared our data and images to similar studies from 2004-2007 and found that the spots on the star are changing in number and becoming more widespread on the surface of the star.

Board 4

Nick R. Baker

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

The light, "proton-rich" selenium nuclei show strong evidence of both individual and collective behavior of their constituent nucleons. The amount of collective behavior (typically in the form of rotation) depends sensitively on the number of neutrons in each selenium isotope. More neutrons generally correlate to more collectivity. The goal of this project was to see how the structure of the selenium-71 nucleus fits within the existing systematics developed by its neighboring selenium isotopes. This work showed that selenium-71 (37 neutrons) appears to exhibit both the individual-particle behavior of selenium-69 (35 neutrons) and the strong collective behavior of selenium-73 (39 neutrons).

Evidence of Multiple Negative-Parity Band Structure in ^{71}Se

The existing level structures of the light selenium isotopes show strong similarities among the positive-parity states. Each shows an organized grouping of excited states (or band) that is built upon a state with a spin-parity of $9/2^+$ and which extends to high spin with similar gamma-ray transition energies. However, the situation is less clear for the excited states with negative parity. In ^{73}Se, multiple negative-parity bands have been observed with energy spacing indicative of strong rotational behavior, but in ^{69}Se, the transition energies in the negative-parity bands are typical of strongly reduced collectivity. So far, only one negative-parity band has been observed in ^{71}Se, so it has been difficult to use this nucleus as a case study in understanding how the level structure evolves between these two very different cases. Thus, the goal of the present work was to extend the level scheme of ^{71}Se as much as possible, with an emphasis on finding new negative-parity states. ^{71}Se nuclei were produced at high spin following the ^{23}Na + ^{54}Fe fusion reaction at Florida State University. Gamma-ray transitions between the excited states were collected in coincidence using a high-resolution array of 10 Ge detectors. From the coincidence relationships, a candidate for a new negative-parity band was found, and known bands were verified. Cranked-shell model calculations indicate that the new band is associated with a structure that demonstrates rigid-body rotation at high spin.

Board 5

Andrew Riley

Faculty Mentor: Kim Lance
Department of Chemistry

As society grows more conscious of its devastating impact on the environment, research must take place to reduce this impact. This is precisely the goal of green chemistry: to replace chemical processes that are harmful to the environment with those that have minimal effect at all. Our research project this summer has focused on creating a catalyst that would allow water to be purified with hydrogen peroxide rather than the harmful chlorine that is used today. Although headway has been made, much more work will be done in order to achieve this lofty goal.

Preparation of Complexes as Robust Catalytic Oxidants

Motivated by the body's ability to oxidize toxins in the liver and kidneys via cytochrome P-450 a diamine-diamide macrocycle ligand was proposed to perform aerobic oxidation of substrates. This ligand would produce an oxidative catalyst that is theoretically highly resistant to self-oxidation because it lacks weak bonds where oxygen could be inserted. In result, the catalyst would have a large turn-over rate before becoming ineffective.

The first step in synthesizing this macrocycle involves reacting an ortho-substituted dihalide benzene ring with 2-aminoisobutyric acid. Through a variety of catalytic systems and reaction conditions we investigated this substitution reaction. Initially copper(I) was used as a catalyst for this reaction due to its literature precedent in the mono-substitution reaction. However, spectral data suggests that these conditions produced only the mono-substitution product. We believe this to be the result of steric hindrance, created by the methyl groups, preventing two substitutions from taking place.

In order to overcome steric hindrance, we began investigating a palladium catalyst. Khramov et. al. reported four substitution taking place on a tetrahalide benzene ring. In addition, they reported that sterics were not an issue. This proved encouraging until solubility issues arose. Literature universally used toluene as a solvent; however, 2-aminoisobutyric acid is insoluble in toluene. The resulting reaction produced poor yields of any isolated products.

Board 6

Randi Amstadt and Tayler O'Connell

Faculty Mentor: Jennifer Yates
Department of Psychology

In the US, there are approximately 225,000 people currently living with a spinal cord injury (SCI). While trauma of this kind cannot be prevented, certain pharmaceutical interventions may be able to stop the initial injury from worsening. A guinea pig model of SCI was used to test a treatment, Glial Growth Factor-2 (GGF-2), that has the potential to aid in the recovery of sensory and motor function following SCI. GGF-2 is in the preclinical testing phase and may eventually be used in human patients.

Effects of Glial Growth Factor-2 (GGF-2) on Sensory and Motor Function Following Spinal Cord Injury in the Guinea Pig

Central nervous system insults, while varied in cause, tend to share secondary pathological processes which worsen the initial injury. Stroke, experimental autoimmune encephalomyelitis (EAE), an animal model of Multiple Sclerosis, and spinal cord injury (SCI) are followed by processes such as demyelination, inflammation, and apoptosis. Glial Growth Factor-2 (GGF-2), a neurotrophic factor produced by neurons, has been shown in EAE and stroke models to increase remyelination, inhibit apoptosis, and decrease inflammation. Because of similarities between the models, GGF-2 has been proposed as a pharmaceutical intervention for SCI. Female Hartley guinea pigs were injured by lateral compression of the spinal cord at thoracic vertebra 12 (T12). Starting at 5 hours post-injury, subcutaneous injections of either GGF-2 or vehicle were administered once daily. Placing, toe spread, and *cutaneus trunci* muscle (CTM) reflex tests were performed to evaluate motor and sensory function. In moderately injured animals, a decline in function caused by secondary pathological processes is typically seen during days 1-3. Sensory function (as assessed by CTM reflex) in moderately injured animals receiving GGF-2 did not exhibit this decline. Although motor function scores did not greatly differ between the two groups, the vehicle group failed to display the typical trend of secondary decline. Encouraged by the sensory data from this pilot study, future research will be performed in effort to draw significant conclusions with a larger sample size.

Board 7

Jack M. Stenger

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

Why to birds look so worn and tattered in the late summer? Why do they molt their feathers? We have explored two processes that may account for the disheveled appearance of birds in the late summer: bacterial degradation of the feathers and abrasion by airborne particles. In addition we have looked the combination of these processes on brown, black and white feathers given that we know some pigments increase the durability of feathers.

The Effects of Feather-Degrading Bacteria on Physical Abrasion of White and Melanic Feathers

Bacillus licheniformis degrades feathers under laboratory conditions. However its effect on the plumage of wild birds is unknown. The plumage of wild birds is subject to many forms of damage (i.e., wear at joints, collisions with twigs, etc., particulate abrasion, and bacterial degradation). It is unlikely that any of these is the sole cause of feather damage. More likely they all contribute synergistically. We hypothesize that bacterial action does not directly cause feather breaks, but reduces durability, thereby rendering feathers more susceptible to physical abrasion. Further, we believe synergistic damage is a selective pressure for color. We inoculated white, eumelanic, and phaeomelanic secondary feathers from domestic chickens *Gallus gallus* with *Bacillus licheniformis*, a feather-degrading bacterium. We did not inoculate control feathers. We placed feathers in jars to simulate natural conditions of moisture and temperature to which a typical feather is exposed. Every week we removed feathers and blasted them with a stream of powdered glass. We counted barbs on each feather before and after exposure. This experiment increases our understanding of the process of feather damage.

Board 8

Jenna Sroka

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

The beekeeping industry, essential for crop pollination and honey production, has been threatened for years by the Varroa mite. This parasite is currently controlled using chemicals that may be retained in honey products. A potential fungal treatment for this mite is being developed, and this study was intended to observe how and why this fungal treatment works using microscopy. Fungal spores appear to accumulate by hairs and cracks on the mite body, where they may cause damage to and death of the mite.

A Scanning Electron Microscopic Study of *Metarhizium anisopliae* Infection of the Varroa Mite, A Parasite of Honeybees

Varroa jacobsoni, or the Varroa mite, is a honeybee (*Apis mellifera*) parasite capable of devastating honeybee hives. Current chemical methods for treatment of Varroa-infested honeybee hives are known to leave residues in honey products and are becoming less effective as the Varroa mites acquire resistance. An alternative biological treatment is *Metarhizium anisopliae*, a fungus that is pathogenic to Varroa mites and has been shown to significantly decrease the mite load within a honeybee hive as effectively as chemical treatments. However, the mechanism of infection by this fungus to the Varroa mite is not documented or well understood. *M. anisopliae* spore paddies were applied to three beehives in central Ohio that had initial mite loads of 5-15 mites as detected by an ether roll test. All mites and debris that fell from the hives were collected every 24 hours for 16 days. Mites were analyzed using scanning electron microscopy (SEM) for the presence of ungerminated and germinated *M. anisopliae* spores or damaged mites. Two mites were incubated on water agar to encourage spore germination before SEM observation. Mite samples from days 12 and 42 from a different *M. anisopliae* spore treatment were also examined. Spores appeared to accumulate in the junctions of plates on the ventral mite surface and at the base of setae on both the dorsal and ventral mite surfaces. Debris also tended to accumulate at these locations suggesting that they may serve as nucleation sites and help facilitate fungal infection. Patterns of discoloration and possible shell damage around spores were also observed and may be the effects of enzymes produced by the fungal spores to initiate infection. Incubation on water agar resulted in noticeable spore germination and is, therefore, a useful procedure for obtaining evidence of spore viability and progression of fungal infection.

Board 9

Elizabeth B. Mayers

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

Plants can respond to both light (phototropic) and gravity (gravitropic) stimuli. The goal of this research is to elucidate how the photo- and gravitropic responses interact and compete for expression.

Interaction Between Root Phototropism and Gravitropism in *Arabidopsis thaliana*

Although they are non-motile, plants have highly evolved sensory systems that allow them to grow towards resources such as nutrients, water, and light. In particular, light and gravity are both sensed in the root cap and produce differential growth in the elongation zone of the root. This overlap between photo- and gravitropic signal transduction pathways has not yet been fully characterized and provides an excellent model system to study growth regulation in roots. In order to tease apart responses to gravity and light in roots, we made use of several mutants in *Arabidopsis*. To analyze the influence of gravity stimulation on the attenuation of phototropism, we compared the wild-type phototropic response to that of *pgm1-1*, a mutant in starch biosynthesis with reduced gravity sensing. We found that while wild-type roots respond to a directional blue light cue sooner than roots of *pgm1-1*, the gravity sensing mutant showed greater overall curvature. Because both gravi- and phototropism are mediated in part by an auxin asymmetry, we studied the phototropic response of the *pin3* mutant, which is disrupted in a root cap-specific auxin efflux carrier. We found that this mutant shows a reduced phototropic response in roots, suggesting a role for auxin efflux in modulating root phototropism. We tested this possibility using confocal microscopy on roots expressing an auxin-responsive promoter fused to GFP. While this reporter line has previously been used to demonstrate an auxin asymmetry following gravistimulation, we found no evidence of such a gradient following phototropic stimulation. Finally, we are in the process of analyzing root phototropism in the absence of ensuing gravity stimulation by using an image analysis-based feedback system. Preliminary results indicate that roots are capable of long-term growth away from directional light.

Board 10

Lauren A. Smith

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

The brilliant colors of parrots are produced by pigments unique to parrots. The redder the color the more resistant the feather is to bacterial degradation. We found that those parrots with the least degradation-resistant plumage were significantly more likely to inhabit arid habitat than those with more degradation-resistant, redder plumage.

The Geography of Coloration in Parrots

Feathers that contain melanin degrade more slowly than those that lack melanin, which suggests that melanin strengthens feathers or inhibits microbial degradation. Birds in humid habitats, which facilitate bacterial growth, are more likely to have feather-degrading bacilli in their plumage and are darker than birds in arid habitats. Like the melanic feathers of songbirds, red, orange, and yellow feathers of parrots have antibacterial properties that enable them to resist damage by feather-degrading bacteria. The pigments that provide these colors are psittacofulvins, which occur only in parrots, and, unlike the carotenes of songbirds, are synthesized by the parrots. The similar anti-bacterial effect of psittacofulvins and melanin suggest that similar biogeographic relationships, for example Gloger's rule, may exist among differently colored parrots as exist among birds with differing shades of melanic feathers. For each species of parrot, we estimated the percentage of surface covered by a particular color and compared the humidity and temperature of each parrot's range to its colors and pattern to see if trends in the distribution of color emerged.

Board 11

William Kenny

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

This study was focused on tiny electronic components, made out of superconductors, called Josephson Junctions (JJs). JJs have many interesting attributes, which lead to many possibilities for studying them, particularly in relation to their potential applications in quantum computing. JJs have certain qualities which may allow them to act as quantum bits in a quantum computing, making computers significantly smaller and faster with more memory capabilities. This study focused on searching for quantum synchronization of JJs, an important step in the realization of JJs as quantum bits.

Toward a Study of Synchronization in Quantum Mechanical Josephson Junction Arrays: Results

Numerical methods of simulating dissipative quantum systems were studied with an eye toward looking for evidence of quantum synchronization in Josephson Junction (JJ) arrays. JJs are of interest because of their potential application in quantum computing as quantum bits. Synchronization between JJs is an important step in realizing this application. Classical synchronization among JJs has already been studied, and we were able to replicate such synchronization among JJs in an array coupled to a nanomechanical oscillator (NMO). Quantum synchronization of JJs, however, has yet to be studied in detail, and is a major focus of our research. Quantum mechanically, various methods exist to model the dissipative interaction between JJs and their environment (damping), including the quantum jump method and the quantum state diffusion method[1]. For example, in the quantum jump method, at random points in time, the system loses energy to its environment, and the system "jumps" down a quantum state. Using this method, we studied the two-state JJ (qubit) coupled to an NMO and the quantum kicked pendulum, in which the pendulum experiences a position-dependent angular impulse at regular time intervals. Studying the two-state junction system, we were able to show resonance between the junction and the NMO in the form of Rabbi oscillations, which we will discuss. The kicked pendulum is a system that has many similarities to a JJ biased with a dc current greater than the junction's critical current. We have preliminary results for the quantum mechanical behavior of the damped, kicked pendulum.

Board 12

Morgan Waddles and Max Schroeder

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

Songbirds of the continental United States have been found to harbor bacteria that are capable of degrading feathers; essentially, breaking them down. We were interested in determining whether the spore-forming bacteria that we are familiar with are also present on the 'Elepaio, a bird that lives only on the Hawaiian Islands. However, we did not find these bacteria on any 'Elepaio feather samples, possibly because the volcanic island soils of Hawaii may too acidic to allow these bacteria to survive.

Hawaii's 'Elepaio is not host for common feather-degrading bacilli

The 'Elepaio (*Chasiempis sandwichensis*) is an endemic songbird of the Hawaiian Islands. It is brown or gray with white markings, and the plumage coloration differs considerably among the islands of Hawai'i, O'ahu, and Kaua'i. Elepaios of dense rain forests are darker than conspecifics of dry, open woodlands. The correlation of dark pigmentation with humid habitats is widespread among birds and is known as Gloger's Rule. Melanin, which is the dark pigment, increases resistance to bacterial degradation. In Song Sparrows (*Melospiza melodia*), the dark color in humid habitat was associated with greater activity of feather-degrading bacilli than in arid habitat frequented by pale Song Sparrows. We intended to determine whether these feather-degrading bacilli were also present in 'Elepaio populations and then explore whether there was a similar impact by plumage pigmentation. Interestingly, we were unsuccessful in isolating feather-degrading bacilli from 'Elepaio feathers and associated Hawaiian soil samples using methods developed during previous studies. The feather-degrading bacteria of interest are known to thrive in alkaline environments, yet the soil of volcanic islands is acidic, which may explain the absence of feather-degrading bacilli. We plan to continue studying the Hawaiian soil in hopes of identifying a different species of feather-degrading bacteria that we may subsequently look for on the feathers of the 'Elepaio.

Board 13

Evan Bai

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

To cope with environmental conditions, plant roots grow in response to both gravity and nutrient availability. We performed this study to test how *Arabidopsis* roots respond to gravity when they are grown under low nutrient conditions. Results show that lateral roots respond to gravity faster and greater under low nutrient conditions.

Phosphate Availability Affects the Architecture and Gravitropic Responsiveness of the Roots of *Arabidopsis thaliana*

Gravitropism is the ability of plant organs to grow in response to the direction of gravity. Generally, plant roots show positive gravitropism: they grow downwards into the soil to take up water and nutrients. Primary root tips reach vertical whereas lateral root tips stay at specific, non-vertical setpoint angles. In addition to gravity responses, the ability of the root system to respond to nutrient availability is another key adaptive behavior allowing plants to cope with environmental conditions. Phosphate, a macronutrient essential for plant growth, is highly immobile in soil and its acquisition depends strongly on root system architecture. Phosphate starvation causes *Arabidopsis* root system to undergo changes in lateral root length, number and density. Phosphate availability also has been shown to alter the distribution and sensitivity of auxin in the root system. However, the relationship between gravitropic responsiveness and phosphate availability in *Arabidopsis* roots has never been carefully studied. The goal of this study was to quantify changes in set-point angle of lateral roots, growth rate and curvature rate of both primary and lateral roots under low phosphate availability. We used time-lapse image analysis on *Arabidopsis* wild-type roots and a variety of mutants in the gravity sensing and signal transduction pathway. We found that wild-type lateral root tips shifted setpoint angle toward a more vertical orientation under low-phosphate conditions, a finding contrary to previously published reports carried out with bean species. This shift in setpoint angle was also observed in several of the mutants we analyzed. Further, we found that lateral roots grown under low phosphate conditions responded to gravistimulation with both a greater rate of curvature and a greater overall magnitude of response than roots grown on full-phosphate media.

Board 14

Emily Turner

Faculty Mentor: Kim Lance
Department of Chemistry

The goals of this project are to create a molecule that can be complexed with a metal, specifically iron, that will form a catalyst that is resistant to oxidation. If the project is successful, the catalyst will be capable of being used in reactions to oxidize environmentally hazardous by-products, rendering them harmless to the atmosphere. The catalyst could also potentially be used to oxide hydrogen peroxide in the process of water purification.

Preparation of Complexes as Robust Catalytic Oxidants

As we are entering the age of Green Chemistry, the discovery and synthesis of complexes resistant to oxidation are of interest to be used in the oxidation of environmentally hazardous substances and as green catalysts in the oxidation of hydrogen peroxide. Our goal this summer was to synthesize a 12-macrocycle porphyrin with diamide diimine structure and complex this with a first row transition metal. We successfully synthesized, isolated, and characterized the protected diamide diamine, N,N'-1,2 phenylenebis[2-methyl-2-phthalimidopropanamide] by reacting α-aminoisobutyric acid and pthalic acid, followed by the addition of thionyl chloride, then o-phenylenediamine. We successfully synthesized, isolated and characterized the deprotected diamide diamine, N,N'-1,2-phenylenebis[2-methyl-2-methylpropaniamide] by reacting the protected product with hydrazine. We successfully synthesized and characterized the macrocyclic diamide diimine by reacting the deprotected diamide diamine with Benzil (diphenylethanedione).

Board 15

Alex Friedman

Faculty Mentor: Chris Wolverton
Department of Botany-Microbiology

Our lab focuses on the way plant roots respond to gravity. This summer we investigated the influence a potassium ion channel has on this gravity response. Using root imaging systems we observed the gravity responses of two mutants. To further support its role, we have also begun manipulations of the ion channel, including enhanced gene expression and the visualization of the plant hormone, auxin.

The Role of the *Arabidopsis* Potassium Transporter in Root Gravitropism

Plant roots are extremely responsive to gravity, which is sensed by the sedimentation of starch-filled plastids in the root cap. Following perception, the gravity response is regulated by the asymmetric distribution of the plant hormone auxin. The isolation of mutants in plastid sedimentation and auxin signaling pathways demonstrate the importance of both of these processes in root gravity responses, but also suggests that other signaling pathways are required for full gravitropic responsiveness. One possible alternative pathway is ionic signaling, which has been shown to undergo rapid changes within seconds following reorientation of the root relative to the gravity vector. Previous research in our lab has focused on the *Arabidopsis* Potassium Transporter, AKT1. We found that a T-DNA insertional mutant, *akt1-1*, has a reduced gravitropic response in roots, suggesting a role for this channel in the regulation of gravity sensing or response pathways. In addition to confirming this phenotype, here we report that another mutant allele of AKT1 shows an enhanced gravity response, further supporting a role for this channel in gravitropism. To test the contribution of this channel to gravity signaling, we are seeking to express the AKT1 cDNA under the control of the constitutive 35S plant promoter. We cloned the AKT1 cDNA into a plant expression vector using recombination-based cloning and confirmed the proper identity of the recombinant vector by PCR and restriction enzyme analysis. We then transformed the recombinant vector into *Agrobacterium* in preparation for plant transformation. Finally, to test whether the AKT1 channel plays a role in auxin flux, we transformed akt1-1 mutants with the auxin-responsive promoter-reporter fusion DR5::GFP. We designed a screen for transformed mutants and are currently selfing T3 transformed plants that scored positive by PCR for both the *akt1-1* allele and DR5::GFP transformation.

Board 16

Kofi B. Quaye

Faculty Mentor: Matthias Buck
Department of Physiology and Biophysics,
Case Western Reserve University

Ras family GTPases deregulation has been of important concern in regards to cancer. Recent studies show that phosphorylation by active kinases governs the function of certain GTPases throughout the body. Studies also show that Calmodulin, a calcium binding protein, also regulates the function of GTPases. We have sought out to determine the effects, if any, of GTPase phosphorylation on Rac1 and how this relates to Calmodulin binding of GTPases.

cMet/Eph Phosphorylation of Small GTPases, their Role in Cancer, and Interactions with Calmodulin

GTPases serve as classical on or off switches in the cell signaling cycle whether bound to their respective nucleotides of GTP or GDP. Ras family GTPases, for example Rac1, play pivotal roles in transcription of genes for cell growth. Recently, this group of GTPases has been of great concern due to their suspected, yet unknown role in cancer; studies show that in over 30% of all cancers, Ras is mutated and permanently turned on sparking metastatic growth. Much of the upstream and downstream effector proteins in the GTPase signaling cycle are mediated by serine/tyrosine phosphorylation, so we propose that phosphorylation of Rac1 also serves as an additional level of control in the GTPase signaling cycle. Furthermore, research have shown that Calmodulin (CaM), a major Ca^{2+} binding protein with four EF-motifs, binds to small GTPases and alters their function. Accordingly, we propose that Rac1 also binds to Calmodulin and modifies its functional behavior. To test these hypotheses, purified Rac1 and Cdc42 GTPases were overexpressed in *E. Coli* bacteria, then phosphorylated by commercially available EphA2 and EphB2 kinases. Kinetic and binding assays were then created and monitored by a GST affinity column. Western Blotting was then used to examine the binding extent between different strains of Rac1 and the Ras binding domain (RBD). To investigate the potential for CaM binding, Circular Dichroism (CD) spectroscopy was used to monitor changes in the secondary and tertiary structures of Rac1 upon association with lipids and membrane mimics. Results show that phosphorylation increases the rate of hydrolysis and dissociation of Rac1 from its effector RBD, and CD spectral analysis indicated that Rac1 binds to Calmodulin.

Board 17

Qingshan Yang

Faculty Mentor: Carmen W. Dessauer
Department of Integrative Biology and Pharmacology, UTHSC-H

Adenylyl cyclase (AC) is important enzyme converting ATP into cyclicAMP. The enzyme has different regulators such as G proteins, AKAPs, protein kinases. They interact with catalytic core region of C1 and C2 formed domains, and also N-terminus. The experiments show that N-terminus of some AC isoforms interact with G proteins, AKAP 79, AKAP Yotiao and mAKAP while some of them do not.

Screening for Adenylyl cyclase N-terminus interaction with G proteins and AKAPs

Adenylyl cyclase (AC) catalyzes conversion of ATP to cyclic AMP, an important second messenger in physiological functions. The alpha subunit of the heterotrimeric G protein Gs stimulates AC to produce cyclic AMP. AC is membrane bound, and is composed of a cytosolic N-terminus, a transmembrane domain [M1], a cytoplasmic domain [C1], and a repeat of these domains [M2] and [C2]. The C1 and C2 domains form the catalytic core and the N-terminus (NT) is also important for regulator interactions. There are nine isoforms of transmembrane ACs and these are regulated in isoform specific manner. ACs are regulated by G-proteins, anchoring proteins (AKAPs), forskolin, and protein kinases. All isoforms are stimulated by GTP bound $G\alpha s$. $G\beta\gamma$ inhibits AC 1, 3 and 8; it stimulates AC 2, 4, 5, 6 and 7 in presence of Gs. Studies show that $G\beta\gamma$ binds to C domains in AC2, but also NT-AC5 and 6. Unpublished results from the lab show AKAP79 binds to the NT-AC5 while AKAP Yotiao binds to NT-AC2. The goal of the project was to determine whether N-terminus of other ACs, namely AC3, 6 and 9 interact with G-protein subunits, AKAP79, Yotiao or mAKAP.

GST-tagged NT-AC6 and 9 were purified using glutathione agarose resin. In GST pull down assays using NT-AC 2, 3, 5, 6, and 9, it was found that GDP.$Gs\alpha$ and $G\beta\gamma$ bind to NT-AC 6 and 9. No binding was observed with GST alone or with GST-NT AC3. AKAP79 binds NT-AC5, 6 and 9. Additional studies with Yotiao and mAKAP are in progress.

Board 18

Nalin Vutisalchavakul

Faculty Mentor: James Cobble
Los Alamos National Laboratory

High-energy laser of up to 200-TW enabled experimental researches in high-energy density physics and laser-matter interaction. When the laser beam hit the target, X-ray radiations were produced. Different types of diagnostic devices were used to study the properties of the radiations. The results of this research can be used for diagnostics at other inertial confinement fusion facilities.

X-ray Diagnostics for Inertial Confinement Fusion Research at Trident Laser Facility

With the 200-TW laser at the Trident Laser Facility, experiments on x-ray backlighting were performed. The sub-ps short pulse laser with energy up to 100 J can be shot on targets with different atomic number. The focused laser beam has intensities up to 10^{21} W/cm^2. The high energy laser interacted with the targets, producing X rays due to K-shell emission. Among other diagnostic devices, a Laue X-ray spectrograph was used to record the x-ray spectrum, which showed emission lines and bremsstrahlung radiation. The Laue spectrograph uses a LiF(200) crystal to disperse the x-ray spectra with a bandpass of 17-70 keV. The spectra were recorded using Fuji image plates. The Laue instrument was designed to include a tungsten shield in the front, a magnetic trap, and a light trap to reduce background noise. Kα lines of Mo, Ag, and Sn were observed.

Board 19

Rebecca J. Sisson

Faculty Mentors: Shuk-Mei Ho, Saikumar Karyala
Department of Environmental Health, University of Cincinnati

During early stages of prostate cancer the cancer cells are dependent on testosterone and other androgens for growth and survival. This makes the cancer easy to treat with androgen ablation therapy. After the cancer progresses the cells become independent of androgen making the cancer metastatic and incurable. My project tested the differences in regulation of small RNA sequences called microRNA in independent and dependent prostate cancer cells. This knowledge will help to determine the pathways prostate cancer cells use in becoming androgen independent and could possibly help stop the metastasis of these cells.

Role of MicroRNAs in Prostate Cancer Prevention

Prostate cancer is the second leading cause of cancer death in American men. In its early stages prostate cancer cells are dependent on androgen for growth. At this stage prostate cancer can be treated, and often cured, with androgen ablation therapy. However, in more advanced cases, prostate cancer cells develop growth pathways independent of androgen making the cancer incurable. There are several proposed pathways that could lead to this independence. Small, non-coding microRNAs have been shown to have oncogenic effects through gene silencing and could be involved in the development of androgen-independent prostate cancer.

Goal and rationale:
The overall goal of this study is to discover dysregulated miRNA-mRNA interactions and networks critical for progression of prostate cancer to androgen-independence. Understanding the mechanisms by which prostate cancer progresses to androgen independence is critical for identifying potential therapeutic targets and for developing multi-targeted approaches to treat androgen-independent prostate cancer. We have used an androgen independent prostate cancer cell line, CS-LNCaP, which was cultured from the androgen-dependent LNCaP cell line. These two cell lines along with three other androgen-independent cell lines and prostate cancer clinical samples, will be used to study the role of miRNAs in androgen-independent prostate cancer. The study followed these three specific aims:

Aim 1: Identification of miRNA and their mRNA targets critical for AIPC using functional genomic approaches.
Aim 2: Functional Characterization of miRNAs and their mRNA targets.
Aim 3: Validation of miRNA expression and their targets at protein level, in PCa clinical hormone-refractory).

Board 20

Natalie Cunningham

Faculty Mentors: Barbara Andereck[1] and Jim Krehbiel[2]
[1]Department of Physics and Astronomy, Ohio Wesleyan University,
[2]Department of Fine Arts, Ohio Wesleyan University

The lives of the inhabitants of Southeastern Utah in the twelfth and thirteenth centuries are of great intrigue to archaeologists, anthropologists, and now possibly astronomers. Our work at twenty small, largely ceremonial sites in the canyonlands revealed five shrine sites where prehistoric Anasazis were paying close attention to the motion of the sun and moon. This work greatly expands our understanding of how much, where, and in what ways these people were watching and tracking the sky, as well as shedding light on their motivations in constructing these sites.

Astronomy of the Anasazi of Southeastern Utah: Shrine Architecture

With no written record and scattered descendents, it is challenging to uncover the history of the Anasazi. They concentrated around Chaco Canyon between 900 and 1130 A.D., where their architecture and rock art sites indicate a strong interest in lunar and solar events. Drought was part of a diaspora in 1130 when thousands of dwellings were built in the Four Corners, only to be deserted around 1280. Astronomical rock art and architecture appears at later sites: Hovenweep, Mesa Verde, Yellow Jacket, etc.

Astronomy may answer some key questions. There are curious trends in less-explored sites in Southeastern Utah. Unlike Mesa Verde and other Pueblo III areas, many Utah kivas are isolated from habitations. This prompts questions: why would their building habits be different, and why would they choose these locations for kivas? Solstice marker petroglyphs have been identified in the region, so astronomical connections could be the answer.

Knowing basic paths of the sun and moon between 1130 and 1280, we visited twenty sites throughout Southeastern Utah, targeting isolated kivas. Using a Brunton transit, topographic maps, and observation of architecture and landscape, we found solar and lunar alignments at fourteen sites. Five sites contained "shrines," each built of one, two, or three distinctive rocks in man-made arrangements. From each rock formation, we found lunar and/or solar alignments with specific features on the horizon. This evidence implies that the Anasazi were tracking and marking the motions of the sun and moon at these sites, and therefore that the placement of the sites may have been dependent on their ability to view the equinoxes, solstices, and lunar standstills. There are further results to be compiled on these sites, others visited, and many more with similar properties yet to be investigated. Each site adds to the story of who the Anasazi were and presents more evidence of their connection with the natural world.

Board 21

Kelly L. Haines and Jenna Sroka

Faculty Mentor: Erin R. Murphy
Department of Biomedical Sciences, Ohio University

Shigella dysentariae is a species of bacteria that infects people causing severe diarrhea that can be life threatening. Small molecules of RNA (sRNA) can play a role in regulating the expression of specific genes including *virB* a gene necessary for infection by this bacterium. This research was done to determine the factors that are needed for these sRNA molecules to repress the *virB* gene therefore preventing infection. More work needs to be done to determine these factors.

The Hunt for Factors Required for Repression of *Shigella* virB Expression by the Small RNA RyhB

Shigella dysenteriae is a gram negative facultative anaerobe that can cause shigellosis through the fecal oral route of infection. Shigellosis is a disease causing severe diarrhea and is most common in toddlers, especially in areas of poor hygiene. *S. dysenteriae* is one of the many species of bacteria that have been revealed to regulate expression of specific gene targets by the activity of small RNA (sRNA) molecules. Specifically, RyhB, a sRNA in *S. dysenteriae*, has been shown to regulate the expression of virulence factors in this bacterium. The molecular mechanism of RyhB-dependent repression of *virB* expression is currently unknown. The goal of this study is to discover the factors needed to repress *virB*, a gene required for infection, by RyhB. A random transposon library was constructed and a mutant identified which no longer displayed RyhB-dependent repression of *virB* expression. In an attempt to identify the mutant gene, DNA was purified from the mutant *S. dysentariae* strain and digested as was a plasmid. A ligation was performed between the digested vector and the digested genomic DNA and then was transformed into *Escherichia coli* cells. Transformed *E. coli* cells were not recovered. A CIP treatment was performed to increase the probability of the plasmid ligating with the DNA, again the DNA and plasmid were digested, ligated and transformed into *E. coli* but again transformed *E. coli* cells were not recovered. Polyermase chain reaction (PCR) was performed on the original *S. dysenteriae* DNA to determine if the transposon was present in the genome of the mutated strain of *S. dysentariae*. This PCR showed the gene was present. Further work needs to be done to determine the factors necessary in the repression on *virB* by RyhB, providing a key molecular determinant in the virulence of *S. dysenteriae*.

Board 22

Britta Buchenroth

Faculty Mentors: Chitra Arumugam and Deepak Kumar
Department of Pediatrics, Case Western Reserve University School of Medicine at MetroHealth Medical Center, Cleveland, OH

The occurrence of bleeding from the lungs is significantly higher in pre-term infants, but what causes the lungs to bleed is still unclear. This study was done to identify and analyze the possible associations between bleeding from the lungs and the clinical characteristics during pregnancy, labor, and the newborn's stay in the NICU in premature babies that are ≤ 1500 grams.

Pulmonary Hemorrhage in Very Low Birth Weight Infants (BW<1500 g)

Etiology of Pulmonary Hemorrhage (PH) is unclear although it occurs in at least 0.5%-11% of VLBW infants. **Objective:** To identify perinatal and neonatal associations of PH in very low birth weight (VLBW) infants. **Methods:** We conducted a retrospective chart review of all VLBW infants with PH between January 1995 - December 2007. PH was defined as active non-traumatic bleeding from Endotracheal Tube associated with clinical deterioration requiring increasing respiratory and additional support. This study was approved by the MetroHealth IRB. Results: From a total of 1772 VLBW infants admitted to the NICU, 107 had PH (6%). Although the incidence of PH in our study was similar to that reported previously, significantly more of our infants (68% versus 50% reported in literature) survived. Lower apgar score at 1 minute was associated with PH. We found that infants born with lower gestational age to younger mothers had significant association with severe bruising at birth. VLBW infants with PH associated death, had the PH significantly much later compared to those who survived or had unrelated deaths.

Board 23

Devon R. Rayasa

Faculty Mentors: Matt Morra
Department of Plant, Soil and Entomological Sciences, University of Idaho

Heavy metal contamination in the popular Coeur d'Alene River Basin has sparked many health concerns in the region. These metals, if found dissolved in the water, could be easily ingested by inhabitants of the region. This study was done to determine where and in what concentration these metals are present. This data can be used to decide if the metals are best left alone or whether more urgent procedures must be taken on the issue.

Wetlands as Sinks for Metals in Mining-Contaminated Coeur d'Alene Basin Soils

Century-old mining activity in the famous Silver Valley Mining District of Northern Idaho has left millions of tons of mine tailings to be deposited into various tributaries of the Coeur d'Alene (CdA) River. Little was done to stop such activities, and, as a result, these mine tailings were left to migrate downstream into the Coeur d'Alene Lake. Concerns over the issue have been rising as the Coeur d'Alene Lake increases in popularity as a tourist attraction. These metals, consisting of elements such as As, Pb, Cu, Ag, etc, have provoked many researchers to question the health risks associated with the basin. Agencies, including the EPA and the USGS, have attempted to quantify and evaluate the condition of the lake and its surrounding tributaries, in an effort to manage the current sediment contamination. These agencies determined that sediments were indeed prevalent in the lakebed soil. However, it was also determined that the contaminants were conveniently trapped in a small oxic layer, keeping it precipitated out of potential water contamination. Research out of the University of Idaho focuses on ponds associated with the CdA basin. It has been established that these ponds mimic the contamination patterns of the lake, in which large amounts of sediments are being trapped in the oxic layer bed of the soil. It is important to determine the integrity of these oxic layers. By doing so, proper actions can be taken to manage the issue.

Board 24

Kristen M. Lear

Faculty Mentors: Charles R. Brown[1] and Edward H. Burtt, Jr.[2]
[1]Department of Biological Science, University of Tulsa,
[2] Department of Zoology, Ohio Wesleyan University

When capturing organisms for scientific studies, the method of capture may affect the subset of the population studied. This can lead to a biased sample of the population and can be especially problematic for studies of population dynamics. This study used two netting methods to capture the colonial nesting cliff swallow and compared the ages of the birds caught using the two methods. Results show a significant difference in age distribution between the two methods; thus netting method affects the ages of the birds caught. Therefore, netting method does affect the sample captured and must be taken into consideration when conducting research using these methods.

Netting Methods Influence Sampled Age Distribution in a Colonial Bird

The way in which an organism is captured may affect the subset of the population sampled. When sampling birds such as the cliff swallow, *Petrochelidon pyrrhonota*, mist netting is often used as the method of capture. However, this involves voluntary flight into the net, which could result in a biased population sample in traits such as age. In our study, we set out to determine whether the netting method used changes the subset of the population sampled. To answer this, we captured cliff swallows using voluntary flight into mist nets and compared those results to results obtained by capturing cliff swallows using a method termed flushing. Flushing involves walking through a colony and driving the birds into the net. In this way, we can help eliminate the potentially skewed results given by voluntary capture. We collected data from a total of 3 sites, using a summed sample size of 3,062 birds, and found a significant difference in age distribution between "flush" and "nonflush" methods. This shows that experimental methods involving netting can give a skewed perspective of a population and that researchers using mist netting should keep this in mind when asking questions about population dynamics.

Board 25

Allison Faucher

Faculty Mentors: Ronald E. Yasbin and Eduardo A. Robleto
Department of Biological Sciences, University of Nevada, Las Vegas

Our work is with mutations that occur during transformation. With increased transcription, the frequency of mutations increase and the chances of one of those mutations being fatal also increase. My project created a strain of argF- *B. subtilis* (unfunctional Ornithine Carboxyltransfertase in the arginine biosynthetic pathway) knocked out. A plasmid will be transformed containing an argF- sequence resulting from a single point mutation at a highly mutable site, so if a mutation occurs to this site during transformation, the argF will revert back to a functionable state.

Constructing an argF- strain of *Bacillus subtilis*

The goal of our research is to determine whether an increase in the level of transcription of a gene results in an increased rate of mutations in that gene. The ability of the single stranded DNA to form secondary stem loop structures (SLS) in the wake of transcription is one factor mediating mutations. Bioinformatic analysis of argF has predicted the formation of stable SLS's with highly mutable bases in the loop. I am interested in testing whether there is a correlation between levels of transcription and accumulation of mutations in the argF gene. To achieve this goal, I constructed a non-polar argF genetic knockout using a kanamycin cassette. I will assay the phenotype of the argF- strain by plating on selective media, to determine appropriate growth conditions for all future work. Also and IPTG-inducible argF construct will be mutated by site directed mutagenesis to contain a stop codon produced by a single base mutation in the argF gene. These constructs once introduced into *B. subtilis* will be assayed for the accumulation of mutations under conditions of arginine deprivation and in the presence and absence of IPTG.

Board 26

Kelly E. Haines

Faculty Mentor: Ruxandra Dima
Department of Chemistry, University of Cincinnati

Clustering is a process that groups objects together by similarities, and can be used to extract information from protein amino acid sequences. Our goal is to group the amino acids that make up the protein fibrinogen according to their free energy. This will allow us to study which amino acids are related for functional purposes, even though they may not be next to each other in sequence or three dimensional space. These long distance relationships could lead to a better understanding of how this blood clot protein is able to stretch in the body and lead to better medical procedures for clot removal.

Data Clustering to Determine the Elastic Properties of Fibrinogen

The goal of the project is to understand the elastic properties of the fibrinogen protein by extracting information from the evolution of its amino acid sequence. Fibrinogen is the main protein component of a blood clot, and therefore its elastic properties are responsible for the clot's physiological role. Understanding the response of fibrinogen when under tension will lead to improved clot removal procedures for the medical field. The evolution of the amino acid sequence is studied using data clustering approaches. This leads to the classification of amino acids (positions) in the protein according to the magnitude of their free energy changes as a result of perturbations (mimicking the effects of tension). The changes in free energy are representative of long distance communcations between positions regardless of their relative locations in sequence or three-dimensional space. The central idea of our approach is that the clusters of amino acids play a role in the stretching process. The results of this research will be used to enhance our current computer model studying the response of fibrinogen to applied forces.

Board 27

Lucas D. Bezerra

Faculty Mentors: Eleana M. Harmel and Kris A. Steinbrecher
Department of Gastroenterology,
Cincinnati Children's Hospital Research Foundation

Guanylate Cyclase C Regulates TNFα-induced Pro-inflammatory Gene Expression in Intestinal Epithelia

Background: The association between cGMP production by Guanylate Cyclase C (GC-C) and gene expression in the intestine is unclear. In other cells in the body, GC-C is the transmembrane protein receptor that starts a signaling cascade by producing cGMP when bound by its ligands guanylin and uroguanylin, which are secreted into the lumen during an inflammatory response. After cGMP production, cGMP activates a number of protein kinases such as MAPK, PKG and PKC which in turn activate the inflammatory factors NF-kB and AP-1. It is unclear whether or not production of cGMP by GC-C regulates pro-inflammatory gene expression in intestinal epithelia. Therefore, we investigated the effects of GC-C and its ability to produce cGMP in mouse models and in vitro tissue culture models. **Methods:** The regulatory affects of GC-C in the intestines were examined by challenging GC-C knockout and wild type mice with Lipopolysaccaride (LPS), an inducer of an inflammatory response. Intestinal epithelial cells (IEC) were isolated from the ileum and colon at different time points. mRNA was isolated from these IECs and RT-real time PCR (qPCR) was conducted to quantify the level of gene expression. In tissue culture, a mouse intestinal epithelia cell line, Mic cl2, was transfected to investigate the presence of GC-C versus a mutant GC-C (D834A) that could not produce cGMP. These transfected cells were treated with TNFa to mimic an inflammatory response. After treatment, RNA and protein were harvested and used in RT-qPCR and Luciferase assays. **Results:** After being treated with LPS, the intestine and IECs of wild type mice showed a lower mRNA expression for the chemokines CXCL1, 5 and 10. In contrast, GC-C knockout mice showed increased mRNA expression for CXCL5 and 10. In vitro, transfected cell lines expressing mutant GC-C (D834A) also showed higher chemokine mRNA expression when compared to those transfected with normal GC-C. **Conclusions:** This work suggests that activation of GC-C may be important during inflammation or infection of the intestine and that strategies to manipulate GC-C function may be useful in the treatment of gastrointestinal disease.

Board 28

Caitlin Hagen

Faculty Mentor: Tracey Spoon
Mystic Aqarium and Institute for Exploration, Mystic, CT

Stress can lead to health problems; most importantly it can lead to immunosuppression. Cortisol levels in can be used to monitor stress. The most common way of measuring cortisol is an invasive method called venipuncture. Venipuncture can cause stress to the animal and risk of infection; saliva provides a safer, non-invasive, alternative for measuring cortisol. The purpose of this study was to validate the use of saliva as an alternate method for measuring cortisol levels in belugas and seal pups.

Assessment of Saliva as a Non-Invasive Method for Measuring Cortisol in Belugas and Seals

Stress can lead to a variety of health problems. One of the main concerns of stress is its ability to negatively impact the immune system. Stress can lead to immunosuppression and increase the chance of illness. Cortisol is a steroidal hormone which is produced in response to stress. The amount of cortisol present can determine an animal's stress level. For marine mammals, cortisol is most commonly measured in the serum or plasma; however these samples require venipuncture for collection. Venipuncture can cause unnecessary stress and risk of infection, thus samples can not be obtained frequently. Saliva provides an alternative method for measuring cortisol levels. Saliva can be collected frequently, is non-invasive, and potentially stress free. The purpose of this project was to validate the use of saliva as a non-invasive method for measuring cortisol levels in the beluga whales and stranded seal pups at the Mystic Aquarium and Institute for Exploration. Saliva samples were collected using cotton gauze and blood samples were collected in lithium heparin tubes. Saliva samples were paired with blood samples collected at the same time. Cortisol levels were measured using commercially available enzyme immunoassay kits. Salivary cortisol levels were compared to paired plasma levels to validate saliva as an accurate measure of cortisol. The validation of saliva as an accurate measure of cortisol in marine mammals would provide a non-invasive method which could be used to monitor stress. The ability to easily detect increased stress in captive marine mammals would give early indications to the possibility of an animal's immune system being compromised. Protective measures could then be taken to help ensure the health of the animal.

Board 29

Sahar Mazhar

Faculty Mentor: Goutham Narla
Department of Genetics and Genomic Sciences,
Mount Sinai School of Medicine, New York, NY

KLF6 is a tumor suppressor gene while KLF6-SV1 is its alternatively spliced form that displays oncogenic properties. Recently KLF6-SV1 has been shown to be overexpressed in patients with lung adenocarcinoma. This study was done to understand the differential response of lung adeocarcinoma patients to the drug Tarceva and determine whether KLF6 and KLF6-SV1 play a role in the downstream effects of this drug.

The Role of KLF6 and KLF6-SV1 in Regulating Response to Tarceva™ in Metastatic Lung Adenocarcinoma

Lung cancer is the leading cause of cancer mortality in the United States. The molecular mechanisms underlying the development of chemotherapy resistance have yet to be fully elucidated. Kruppel-like factor 6 (KLF6) plays a role in development, cellular proliferation, differentiation, carcinogenesis and chemotherapeutic response. Previously, a oncogenic splice variant of KLF6, KLF6-SV1, that is overexpressed in human cancers was identified. It was shown that KLF6-SV1 plays a role in lung adenocarcinoma prognosis and chemotherapy resistance. To further define the role of KLF6-SV1 in chemotherapy resistance, we treated patient derived lung cancer cell lines with Tarceva, a specific, small molecule inhibitor of EGF receptor signaling. Their response to drug was measured via FACS analysis and any changes in KLF6 and KLF6-SV1 at the mRNA and protein level were determined by quantitative real time PCR and western blotting. In Tarceva sensitive cell lines (as determined by induction of apoptosis), the level of the wild-type KLF6 protein increased while the expression of its oncogenic splice variant KLF6-SV1 protein was decreased. Furthermore, targeted reduction of wtKLF6 in these cell lines using RNA interference decreased their sensitivity to Tarceva. In addition, Tarceva sensitivity was restored in resistant cell lines by transfection of siRNAs specific to KLF6-SV1. Combined, these studies highlight a potential role for the KLF6 gene family in regulating chemotherapy responsiveness in lung cancer cell lines and highlight the role of KLF6-SV1 as both a new cancer-specific anti-apoptotic protein and a potential therapeutic target in the treatment of chemotherapy resistant metastatic lung cancer.

Board 30

Sarah Cook and Aurore Thibon

Faculty Mentor: Valerie Pierre
Department of Chemistry, University of Minnesota

Potassium (K^+) is a very important ion in biological systems. Currently, there are no sensors capable of efficiently measuring K^+ concentrations in biological media. This project has worked to develop a luminescent sensor that is selective for K^+ and sensitive for low concentrations. The sensor employs a lanthanide complex, whose luminescence fits the needs of an effective K^+ sensor.

Progress Toward the Synthesis of a Selective Luminescent Sensor for Time-Resolved Detection of Potassium

Potassium (K^+) is an essential nutrient, involved in the muscular and nervous systems as well as regulation of cellular activity. Biologically relevant K^+ concentrations are 3.5-5.3 mM in the blood and 100-140 mM in cells. These concentrations are difficult to measure because sodium (Na^+) is 25 times more prevalent than K^+ in the blood. Currently, no sensor has adequate selectivity for K^+ over Na^+ or sufficient luminescence lifetimes for quantifying potassium concentrations in complex biological mediums. To address these problems, a lanthanide-based sensor is being developed whose selectivity for K^+ is a result of cation-π interactions. The use of a lanthanide complex lengthens the luminescence lifetime of the sensor, thus allowing for the quantitative measurement of potassium. Synthesis of the sensor is in progress.

Board 31

Rita E. Cook

Faculty Mentors: Kristen A. Thoreson and Kristopher McNeill
Department of Chemistry, University of Minnesota

Trichloroethylene (TCE) is a toxic groundwater contaminant that can be reacted with granular iron to form harmless products, but not much is currently known about the reaction. A model complex is used to simplify the reaction and learn more about how it works, but this reaction is done in organic solvents, not water. In order to set up a parallel between the reaction of TCE with the model complex in organic solvents and with granular iron in water, the reaction of granular iron with TCE was studied in organic solvents.

Dechlorination of Trichloroethylene (TCE) using Zero-Valent Iron in Organic Solvents

Zero-valent iron (ZVI) is currently employed to remediate ground water contaminated with TCE, however the mechanism of the dechlorination reaction is not well understood. In order to compare the mechanism of ZVI-mediated dechlorination to that of a well characterized phosphino-iron(0) model complex, dechlorination of TCE with ZVI was studied in organic solvents. The reaction was carried out with 100 mesh iron(0) in oxygen and water-free conditions using THF and toluene as solvents. TCE loss was monitored by GC/MS. The reaction in water-free THF resulted in complete degradation of TCE after several days, but only a 10% decrease in TCE concentration was observed in water-free toluene over the same timescale. The dechlorination reaction in water-free toluene with *tert*-butanol as a proton source was also evaluated.



Board 32

Sara Nienaber

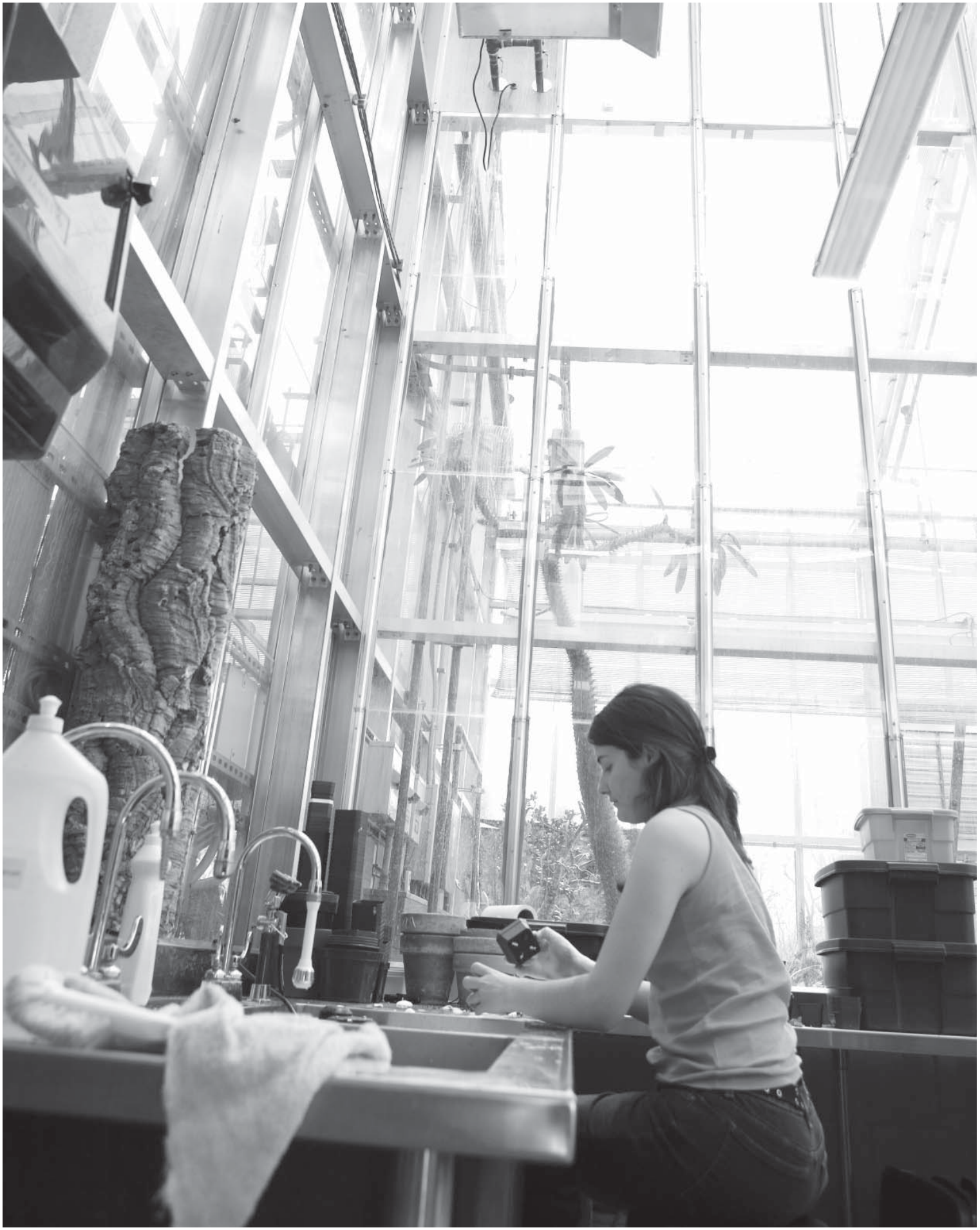
Faculty Mentor: Bruce O'Gara
Department of Biology, Humboldt State University

For this project, I chose to use aquatic worms exposed to iron as a very simple model organism for Parkinson's disease. I wanted to find iron exposure concentrations that would impair the worms' movement, behavior, and giant nerve fiber activity, but not be lethal. After discovering a appropriate test concentration (9 µM $FeSO_4$ for 24 hours), I attempted to protect the nerves from iron toxicity by exposing the worms to excess dopamine. Only the medial giant fiber was protected from iron toxicity by dopamine.

The Effect of Iron Exposure on the Lateral Giant Fiber Activity of *Lumbriculus variegatus*

Iron is an essential element that can be toxic in large quantities. Iron accumulation has been implicated in neurological disorders such as Parkinson's disease, in which iron accumulates in the substantia nigra. *Lumbriculus variegatus* is a freshwater oligochaete worm that has dopaminergic giant fibers. The activity of these fibers can be measured externally, making this animal an excellent model for the measurement of the effects of iron exposure on giant fiber activity. It was determined that 9 µM $FeSO_4$ for 24 hours is an appropriate condition to impair the conduction velocity of both the medical and lateral giant fibers. This concentration can be used in the future to test the ability of different compounds to protect the fibers from iron toxicity. It was shown that simultaneous iron and 0.5 mM dopamine exposure protects the medial giant fiber. In the future it may be useful to investigate other sources of iron, such as ferric chloride, for toxicity studies.





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

Board 33

Lara Kobelt

Faculty Mentor: Nancy Murray
Department of Botany-Microbiology, Ohio Wesleyan University

Volunteering for HWR this summer was composed of a few different aspects: training, healthcare experience, and observation. I attended certification courses, visited patients in various settings, and went to team meetings. I became certified to help bathe, feed, and change patients, and learned how to do other exciting things (like propping a urinal). I ended up learning more about a less widely known (and less utilized) facet of healthcare and gaining experience with patient interaction and communication.

Hospice of the Western Reserve Volunteering

My primary objectives in volunteering with Hospice of the Western Reserve (HWR) this summer were to observe a newer form of healthcare, gaining experience with patient interaction, and attempting to come to terms with the dying process. I became more adept at identifying physical discomfort from physical and verbal cues and at recognizing the shut-down process the body goes through when it is dying. Most importantly, I became increasingly convinced that palliative care is often much more beneficial to a terminally ill patient than a barrage of tests and procedures that only seem to add to a patient's discomfort.

I participated in the following:

- Certification Courses
  - 8 week Training Course—Attended by all volunteers, this training course provided information to volunteers about the goals HWR: In part, maintaining dignity and providing quality of life to the terminally ill.
  - Hands-On Training Session—This is an opportunity extended to interested volunteers, providing basic training that, upon completion, allows the volunteer to assist the nurses or nurses' aids at Hospice House in basic tasks.
- Team Meetings—Team meetings are organized by each branch of HWR. They are attended by every person who is involved in the care of the HWR patients. This includes the HWR physicians, pharmacists, nurses, nurses' aids, social worker, Spiritual Care Coordinator, Bereavement Coordinator, music and art therapists, and volunteer coordinator. These people gather in order to discuss the holistic care of each individual patient. Patients are reviewed and evaluated every two weeks. The review is more detailed upon admission and when there is a change in their status (physical, psycho-social, mental, spiritual).
- Patient Care—The visitation of patients (at their homes or in nursing homes) was also a large part of the volunteer experience.

Volunteering for HWR this summer was composed of a few different aspects: training, healthcare experience, and observation. I attended certification courses, visited patients in various settings, and went to team meetings. I became certified to help bathe, feed, and change patients, and learned how to do other exciting things (like propping a urinal). I ended up learning more about a less widely known (and less utilized) facet of healthcare and gaining experience with patient interaction and communication.



Board 34

Jeffrey Thongsawath

Faculty Mentor: Nancy Murray
Department of Botany-Microbiology, Ohio Wesleyan University

I volunteered in Laos at the Lao Red Cross helping to prepare for a youth peer education program and blood drive. In Thailand, I taught with a Thai teacher at a local primary school. I also volunteered at Krabi Hospital where I was able to rotate between the departments and help hospital staff practice their English. I found that Southeast Asian medicine is evolving from its traditional practices into one in which uses Western medicine to treat against the illnesses believed to be caused by *phi*.

Health and Education in Southeast Asia: Laos and Thailand

At the beginning of the volunteer project, I took part in an intense, three-day immersion into Lao and Thai language and culture in Isan, the northeast region of Thailand. A week was then spent volunteering at the Lao Red Cross in Vientiane, Laos, preparing for a youth peer education program and blood drive. The remaining weeks were spent at a primary school and Krabi Hospital in Krabi Town, Thailand. At the hospital, physicians and nurses were observed in numerous departments including psychiatry, pediatrics, and emergency medicine. I spent time translating between hospital staff and foreign tourists at the International Clinic inside Krabi Hospital, and rotating between departments to practice conversational English with nurses and nurse's aides. Team teaching English with a Thai teacher was also done for an hour each weekday.

Theravada Buddhism is ingrained in both Lao and Thai cultures. Its prepotency can be observed in the peoples' healthcare, education system, government, and everyday life. Upwards of a hundred distinct ethnic groups in Laos and Thailand have been identified, each of which has its own endogenous beliefs. However, a belief in spirits or *phi* is common among all Lao, Thai, and other ethnic groups. Among these groups, *phi* are believed to be the source of illnesses. During my time living and volunteering in both countries over the span of five weeks, I observed a dichotomous element of Southeast Asian medicine. This was the merge of traditional ethnomedical beliefs with Western medical beliefs.

I found that the hospital in Krabi was gravely understaffed, in need of more patient beds, and in need of larger, cleaner, and updated hospital facilities. Krabi Hospital is currently in need of 19 physicians, 11 dentists, five pharmacists, and 191 nurses. Patients admitted into the hospital were mainly from those with dengue fever, appendicitis, hernias, chest and abdomen trauma from motorcycle accidents, tuberculosis, and pregnancy.

Board 35

Laura Coonfield

Faculty Mentor: Laura Tuhela-Reuning
G.W. Burns Scanning Electron Microscopy Laboratory,
Ohio Wesleyan University

Optometrists disagree over whether rubbing lenses helps clean contact lenses more effectively. This project uses scanning electron microscope images to examine the differences in the surfaces of lenses using different treatment methods. This project also tests the recommendation that some optometrists give that contact lens cases should be cleaned regularly to prevent the growth of bacteria which could get on the lenses and cause eye infections. No bacteria were cultured on a case that was used for fourteen weeks without cleaning, and the SEM images are still being analyzed.

Contact Lens Care: An Evidence-Based Approach

The advent of "no-rub" contact lens cleaning solutions led to conflicting optometrists' advice about the most effective method of cleaning contact lenses: some state that, similar to washing hands, rubbing is the most effective way to clean contact lenses whether or not a no-rub solution is used, whereas others state that rubbing contact lenses pushes harmful substances more deeply into the lenses, making these substances harder to remove by cleaning solutions. Contact lenses treated using both methods were imaged using a scanning electron microscope to visualize the differences in the surfaces of the contacts in each experimental group. To determine whether rubbing introduces new harmful substances to contact lenses or more firmly lodges harmful substances already on the surface, the lenses were studied in two groups: unused contacts and contacts exposed to bacteria. To simulate natural conditions, the bacteria that was used was cultured from a contact case that had been used for approximately one year that had never been cleaned, as optometrists report that unclean cases are a significant cause of eye infections with contact use. The images of these lenses are still being examined for results. For a more real-world perspective, a contact lens case was used for ten weeks and then swabbed for bacteria to determine whether regular washing of contact cases is necessary. No bacteria were cultured from this case, suggesting that as long as the case is replaced every few months, cleaning the case is not necessary.

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

Board 36

William P. Heinmiller
Westerville South High School

Faculty Mentor: Barbara Andereck
Department of Physics and Astronomy

Two metronomes of similar (but slightly different) frequencies were placed on a suspended board. The metronomes were monitored as they oscillated. Differences in frequencies of metronome pairs and the mass of the board system were varied and explored. It was found that synchronization occurs for specific values of these parameters.

Synchronization of Coupled Mechanical Oscillators: Exploring the edge of the conditions necessary for synchronization

This study explored the conditions necessary for synchronization of a simple mechanical system—two identical metronomes of similar (but slightly different) frequencies, coupled by sitting on a suspended board. While this study focused on physics, coupling and synchronization of non-linear oscillators are common phenomena in many domains. Some interesting examples include synchronous flashing of fireflies in Southeast Asia, the coherent pulsating of atoms which constitute lasers, and synchronization in electronics. All of these examples, while quite different on the surface, have fascinating similarities at their core—spontaneous order rises from apparent chaos.

In our two-metronome system, synchronization is governed by four key dimensionless parameters. These are β (coupling), θ (driving angle of the metronome), Δ (phase difference between the metronomes), and μ (strength of the metronome driving mechanism). Because the driving mechanism is fixed for each metronome, β and Δ were explored by adjusting the mass of the system and the frequency difference, respectively.

The experimental process included the collection of raw data on the position of the metronome arms as a function of time, analysis of the data and fitting to mathematical models describing the metronome/board motion.

It was determined that, for a given metronome pair, coupled synchronization occurs only for certain ranges of Δ and β. As β decreases and/or Δ increases, the metronomes beat without synchronizing. For certain intermediate combinations of β and Δ, the metronomes beat and then synchronize, indicating the edge of synchronization.

By exploring conditions near the edge of the parameters necessary for synchronization, we hope to better characterize the synchronization phenomenon both for simple mechanical systems and other non-linear oscillators.

Board 37

Robert Anthony
Ohio Wesleyan University

Faculty Mentor: Brad Trees
Department of Physics and Astronomy

Open quantum systems are microscopic structures governed by quantum mechanics and interacting with their environment. Numerical methods were studied to simulate the interactions between the environment and such systems. These interactions are important for studying models of quantum bits, which are the building blocks of quantum computers.

Toward a Study of Synchronization in Quantum Mechanical Josephson Junction Arrays: Methods

Numerical methods of simulating dissipative quantum systems were studied with an eye toward looking for evidence of quantum synchronization in Josephson Junction (JJ) arrays. JJs are of interest because of their potential application in quantum computing as quantum bits. Synchronization between JJs is an important step in realizing this application. Classical synchronization among JJs has already been studied, and we were able to replicate such synchronization among JJs in an array coupled to a nanomechanical oscillator (NMO). Quantum synchronization of JJs, however, has yet to be studied in detail, and is a major focus of our research. Quantum mechanically, various methods exist to model the dissipative interaction between JJs and their environment (damping), including the quantum jump method and the quantum state diffusion method. For example, in the quantum jump method, at random points in time, the system loses energy to its environment, and the system "jumps" down a quantum state. Using this method, we studied the two-state JJ (qubit) coupled to an NMO and the quantum kicked pendulum, in which the pendulum experiences a position-dependent angular impulse at regular time intervals. This poster focuses on describing the quantum jump method, both the theory behind it and its implementation.

Board 38

Jonathan K. Bruckman
Monmouth College

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

Atomic nuclei with an odd number of protons and neutrons ("odd-odd" nuclei) are typically the most complicated ones which, as a result, have the least amount of available experimental information, particularly those nuclei with masses furthest from the stable ones. The goal of this research was to study the structure of arsenic-70, a very short-lived odd-odd nucleus, to see how it compares with the better known structures of other arsenic isotopes. This work showed that the structure of arsenic-70 is more like that of the heavier odd-odd arsenic isotopes than the lighter ones.

Evolution of Collective Structure in Odd-Odd ^{70}As

Previous studies of the odd-odd Arsenic–70 (^{70}As) nucleus have left open questions concerning the high-spin level structure. In particular, there is a "missing" sequence of states with odd spins and negative parity, the expected partner of a sequence of even-spin negative-parity states found in the most recent study. Because of this, it has been difficult to determine how the level structure of ^{70}As fits within the picture developed by its nearest odd-odd isotopes ^{68}As and ^{72}As, which show very different level structures at high spin. The goal of this study was to search for these missing states and to provide a more complete comparison between ^{68}As, ^{70}As, and ^{72}As at high spin. Excited states in ^{70}As were produced following a fusion reaction at Florida State University involving a beam of ^{23}Na accelerated to a kinetic energy of 80 MeV and a thick target foil of ^{54}Fe. Gamma-ray transitions between the excited states were collected in coincidence using a high-resolution array of 10 Ge detectors. From the coincidence relationships, a candidate for the missing odd-spin negative-parity sequence was found, with spins and parities assigned tentatively using systematic arguments. All other high-spin level sequences found previously were confirmed. The kinematic moments of inertia for the new band and those observed previously, calculated within the context of the cranked-shell model, show that ^{70}As is likely dominated by collective behavior at high spin, making it more similar in this regard to ^{72}As than ^{68}As. Thus collectivity and deformation appear to increase with neutron number in the light proton-rich arsenic isotopes.

Board 39

Erica Cross
Youngstown State University

Faculty Mentors: Scott Linder
Department of Mathematics and Computer Science

When looking at bivariate samples we assume there is correlation between x and y. When these data have been censored the sampling distribution is unknown. We will attempt to fit a distribution and test for goodness of fit in order to find an approximation of the sample correlation.

The Correlation Distribution in the Presence of Censoring

In many experimental settings data is subjected to censoring. Censoring mechanisms impose dependence structures on observations which render mathematically intractable the sampling distributions of many commonly used statistics. Here we consider the sampling distribution of the ordinary sample correlation coefficient when bivariate normal data has been subjected to Type 2 censoring on one of its variates. We investigate the goodness of fit of a beta distribution approximation to this sampling distribution, whose parameters depend on experimental conditions. We examine the performance of inferential methods which arise from this approximate sampling distribution.

Board 40

Brooks Emerick
Shippensburg University

Faculty Mentor: Sean McCulloch
Department of Math and Computer Science

The shared shortest path is the shortest way to connect two points but with a small twist: if any portion of that path is shared between two or more travelers, then the cost to travel on that portion is split. Creating a computer algorithm that produces such paths for an arbitrary number of travelers with non-negative costs proves to be difficult. Therefore, creating an algorithm and applying heuristics to approximate the answer was my research focus along with analyzing the configurations of such paths.

Shared Shortest Paths in Graphs

A graph is a set of vertices, or points, connected by edges that may have weights corresponding to the cost to use the edge. A path is a designated list of vertices that describes how to get from a source vertex to a terminal vertex by way of the edges connecting each vertex. This research studied "journeys" which are two vertices that need to be connected by a path of minimal cost. The shared shortest path problem tries to find the shortest path for each journey where each journey divides the cost of edges that are traversed by how many journeys are sharing it. Some graphs reach an equilibrium situation, when no journey can change its path in order to reduce its cost. However, there are instances when no equilibrium emerges and the journeys in such graphs "bounce" between several paths. Finding the true shared shortest path is NP-Complete and so, we created algorithms to approximate the shared shortest path for an arbitrary number of journeys in any non-negative weighted graph. The algorithm we used finds potential approximate solutions by deleting an edge and computing the new shared cost for every journey. If the new cost is better, then costs are updated and the process repeats after replacing the deleted edge. By applying variations to this algorithm we were able to tailor the resulting paths towards various metrics for finding an acceptable solution. Some metrics include finding the minimum sum of all journeys' costs or computing the ratio of cost-lost to cost-saved. Running different variations on the algorithm and performing more tests to find the shared shortest path are among future work projects as well as detecting potential non-equilibrium situations so they can be avoided.

Board 41

Conrad Moore
Bucknell University

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

Stellar Surface Imaging via Light-Curve Inversion

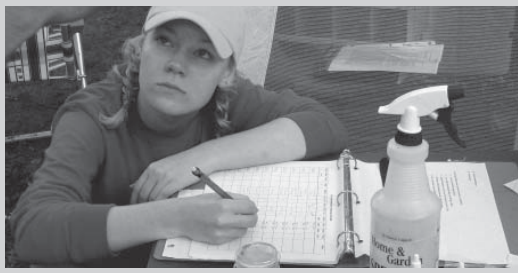
The details of the physics behind how sunspots are created and sustained are still not well-understood. Sunspots are regions of strong magnetic fields (~2-3kG) that suppress convection on the surface of the Sun, causing those regions to emit less light and creating what appear to us as dark patches on the Sun. In this project, we studied the changes in starspots on LO Pegasi. The problem is that there is no telescope powerful enough to directly image the surface of any star besides the Sun, so we use an indirect mathematical technique called Light-Curve Inversion. We took CCD Camera images of LO Pegasi at Perkins Observatory, and used differential aperture photometry to plot the changes in the star's brightness over time, or the star's "light curve". The surface of the star was then imaged by running the light curve through the Light-Curve Inversion program. We present data from the months of June and July of 2008, showing how the spots on the surface of LO Pegasi have changed. By studying how starspots change on other stars, we gain insight into the processes involved in the stellar magnetic dynamo, knowledge which can be extended to expand our understanding of our own sun.

Departmental Honors 2007-2008

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

Student Name	Department	Supervising Professor	Title
Katie Ayers	Zoology	Sarah Leupen	Feedback Regulation of Gonadotropin-Releasing Hormone by Reproductive Steroids in the Axolotl, Ambystoma Mexicanum
Jacqueline Barker	Psychology	Kim Dolgin	Perception of Aggression and Mode of Communication
Lindsay Bertch	Zoology	Ramon Carreno	Speciation in Coral Reef Crabs from Australia
John Betts	Theatre	Ed Kahn	Feminized Male Characters in Contemporary Gay Performance
Elisabeth Calhoon	Zoology	Amy Downing	The Effects of Environmental Disturbance on Pond Ecology
Caitlin Dugre	Physical Education	Nancy Knop	Analysis and Development of Appropriate Motor and Social Development Through Extracurricular Programming
Rebecca Gangwer	Zoology	Denny Radabaugh	Comparative Study on the Social Behavior of Bonobo and Gorilla Juveniles
James Johnson III	Zoology	Ramon Carreno	Pinworm (Nematoda:Oxyurida) Guilds and Host Specificity in the Guts of Cockroaches and Millipedes
Katie Jones	Physical Education	Nancy Knop	The Impact of the Coach-Athlete Interaction on Athlete Personal Development
Shawn Kurtzman	Zoology	Jed Burtt	Microbial Characterization of Alpha Keratin Structures in Reptiles and Birds
Marie McNeely	Zoology	Sarah Leupen	Effects of Whole-Body Odorants on Reproductive Hormone Activity in Ambystoma Mexicanum
Jessica Nare	WGS	Michael Flamm	Attitudes Towards Transgender Identities in the United States
Lauren Reeves	Zoology	Ramon Carreno	A Survey of Parasite Communities in Virginia Opossums (*Didelphis virginiana*) Collected in Ohio and DNA Sequencing Analysis of Mesocestoides supp. Acquired from This Survey
Rachel Ryan	Psychology	Kim Dolgin	Can a Short Term Intervention Improve Preschoolers Street-Crossing Behavior? An Attempt to Hasten an Aspect of Children's Perceptual Motor Development
Kate Shannon	English	Marty Hipsky	From Traditional Realism to High Modernism: The Evolution of Virginia Woolf's Literary Technique
Steven Toaddy	Psychology	Kim Dolgin	Emotional Effects of On-line Social Interactions
Lauren Woods	Zoology	Amy Downing	The Assembly of Freshwater Communities





Index >>

Campus and Off-Campus Researchers

NSF-REU/RET Researchers

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

Where are they now? >>

Success continues for OWU students who did research during the summer of 2007.

Britta Buchenroth

Currently: Working at MetroHealth Hospital in Cleveland, OH through the Chester Summer Scholars Program conducting a clinical research experiment and observing procedures in various departments.

Kelly E. Haines

Currently: REU position in Chemistry at University of Cincinnati

Katie Ayers

Currently: Beginning medical school at Vanderbilt

Lauren Woods

Currently: Beginning graduate work in Ecology at Washington University in Saint Louis

Rachel Fleming

Presented Research: American Society for Microbiology – Boston 2008
Currently: Beginning graduate work in microbiology at Miami University

Jacqui Barker

Presented Research: Association for Psychological Science – 2007
Currently: Beginning graduate work in neuroscience at Yale

Max Schroeder

Presented Research: American Ornithological Union – Laramie, WY 2007
American Society for Microbiology – Boston 2008
Currently: Working on research supported by the American Society for Microbiology Undergraduate Research Fellowship

Steven Toaddy

Currently: Beginning graduate work in industrial/organizational psychology at North Carolina State University

Stacy Ling

Currently: Beginning graduate work in psychology at the University of Cincinnati

Caitlin Chesnut

Currently: Worked during the summer as a day camp counselor at the Powell YMCA

Nalin Vitisalchavakul

Presented Research: American Physical Society, Ohio Section – 2007
American Astronomical Society – 2008
Currently: Spent summer doing research at Los Alamos National Laboratory as part of the National Undergraduate Fellowship by the Princeton Plasma Physics Laboratory

Sara Nienaber

Presented Research: Faculty for Undergraduate Neuroscience (FUN) poster session at the Society for Neuroscience Meeting – San Diego, California 2007
Currently: Working with Bruce O'Gara at Humboldt State University in an Ecology and Evolutionary Biology REU

Danielle Kapolka

Currently: Applying to graduate programs in math

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