Patricia Belt Conrades

Summer Science Research Symposium

SEPTEMBER 15, 2014

Ohio Wesleyan University

NURUL TAIMUR ISLAM

OWU '13, 2011 SSRP PARTICIPANT

CURRENTLY A PH.D. CANDIDATE IN EXPERIMENTAL CONDENSED MATTER PHYSICS AT DUKE UNIVERSITY, ANTICIPATED GRADUATION 2019

"The OWU SSRP was my first hands-on introduction to research, where I learned how to approach a cutting-edge scientific problem from the perspective of a scientist. That thrill and exhilaration of solving real problems inspired me to pursue a career in research. Now, as a graduate student, I develop new approaches for solving interesting and current scientific problems."

THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM

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

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

Contents

Atrium, Schimmel/Conrades Science Center

Monday, September 15, 2014 at noon

Opening remarks by President Rock Jones followed by student poster presentations

Thoughts from the Director

For over two decades, Ohio Wesleyan University students have immersed themselves in research with a faculty member in the Summer Science Research Program (SSRP). The Program encourages students to meld classroom knowledge with practical experiences.

The SSRP provides students the opportunity to learn how to be a scientist by doing science. Students spent ten weeks in the summer working side by side with faculty mentors as the central researcher in the project. They participate in all the steps of the research process, taking ownership of the successes, the failures, and the knowledge gained. The experience allows students to focus and hone their intellectual skills through investigating questions of importance not only to their research group but the wider national and international academic community.

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

Just as importantly, the students share their findings orally at today's symposium. As you talk with them about their work, I encourage you to appreciate the depth of their understanding. They can explain their work because they understand the fundamentals of the project and have been involved in all stages of the research. Many of our students will go on to share their findings at professional scientific meetings and in major scientific journals.

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

Congratulations to all who participated in this exceptional research program.

Martin J. Eisenberg
Summer Science Research Program Director
Dean of Academic Affairs




The Importance of Summer Research on a Career

When I first came to Ohio Wesleyan as student I knew that I wanted to study science. Exactly which scientific discipline was going to become my career was as yet undetermined, but my mind was set on understanding why all the things in the universe did all the things that the universe does.

Following the advice of my academic adviser, I pursued a freshman research fellowship with Dr. Jed Burtt doing research on *Bacillus* bacteria and their ability to degrade bird feathers. I then continued to work with him and Dr. Joe Calabrese on this project over two separate summers through the next four years. Dr. Burtt and Dr. Calabrese taught me that new knowledge was earned not necessarily with brilliance, but more importantly with persistence. They taught me to not expect easy answers, but to measure carefully and to always be asking the next question. To follow an understanding of *what* happened with an understanding of *how* it happened and *why* it happened.

My research experience as an undergrad at OWU not only helped me get into graduate school, it helped me succeed there. I knew how to work, how to question, and how to grind through adversity. Over the course of the next eight years I put that experience to use; assisting on a score of research projects, publishing papers in peer review journals, presenting scraps of new knowledge on how the world works at academic conferences to experts whose books I had read, and earning two advanced degrees. All this led me back to where I began, now qualified to teach here at OWU. And now when I get to consult students as they work to learn how to find answers to the right types of questions and how to share their new knowledge with others, I hope that I can impart some aspect of the grandeur of the endeavor that is scientific research. The goal is to know something that none of the more than 100 billion humans that have spent time on this Earth has ever known before. This is an amazing thing. But to be amazing, one must first be humble and patient enough to learn what those that came before you have learned. So that by standing on the shoulders of giants, you may see what lies over the new horizon.

Daniel F. Fink, Ph.D.
Ohio Wesleyan University
PT Professor of Zoology/Chemistry/Physics

The Making of a Scientist

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

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

During the Symposium this afternoon, you will have the opportunity to interact with 24 students who performed research at OWU mentored by OWU faculty members, seven students from universities other than OWU who worked on campus with OWU faculty, and 9 OWU students who performed research off campus at other universities or in other countries. There is no doubt that the results presented here today are exciting and novel. However, equally exciting is the opportunity for you to speak with each of these young scientists about what discoveries they have made.

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

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




THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM ENDOWMENT

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

Mrs. Conrades is a volunteer registered nurse and homemaker, and a member of Ohio Wesleyan's Board of Trustees. She regularly assists in the operating room of Boston's Mount Auburn Hospital and is also a nurse with Volunteers in Medicine, assisting the poor in Stuart, Florida. Dr. Schneider is a highly regarded Professor of Pathology and Director of the Cytogenetics Laboratory on the faculty of the University of Texas Southwestern Medical Center in Dallas. She also has served on the Ohio Wesleyan Board of Trustees.

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

THE C. PATRICIA FERRY SUMMER SCIENCE RESEARCH PROGRAM ENDOWMENT

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

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

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

Special Acknowledgments

Sources of Support for the 2014 Summer Science Research Program

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

Support for the Patricia Belt Conrades Summer Science Research Symposium

Dr. Nancy Reynolds Schneider '64

Board 1

ALEXANDRA TAVENIER

Faculty Mentor: Tami Panhuis
Department of Zoology

We are studying aspects of sperm quality in mice selectively bred for high voluntary wheel running to determine the effects of endurance exercise on male fertility. To do this we are analyzing the sperm of these mice to look for common abnormalities which are known to impair natural reproduction. If high runner mice have significant differences in sperm quality, such as morphology, motility, and number, relative to the control group, then it is possible that endurance exercise negatively effects male fertility. This study will contribute to our understanding of the relationship between endurance exercise and sperm viability in mammals.

SPERM MORPHOLOGY, MOTILITY, AND NUMBER IN MICE SELECTIVELY BRED FOR HIGH VOLUNTARY WHEEL RUNNING

Endurance exercise in humans has been shown to negatively effect sperm morphology, motility, and number, in turn reducing the possibility of successful fertilization. Abnormalities observed as a result of endurance exercise include immotile sperm, low sperm counts, and morphological irregularities. In the current study, we used an experimental evolution approach to test whether 68 generations of house mice selectively bred for high voluntary wheel running (genetic effects) alters sperm characteristics. We extracted sperm from the caudal epididymis of adult (9-12 weeks) males from four replicate high-runner lines (HR) and four non-selected control lines. Sperm motility analysis was performed using a CASA (computer assisted sperm analysis) system and sperm number counted with a hemocytometer. Following fixed slide preparation and staining, sperm abnormalities (acrosome deficiencies, head and neck irregularities, and broken sperm) were quantified using confocal microscopy with immunofluorescence. Statistical analysis will investigate the effects of selective breeding for elevated levels of physical activity on sperm morphology, motility, and number. This study will contribute to our understanding of the relationship between endurance exercise and sperm phenotypes in mammals.

Board 2

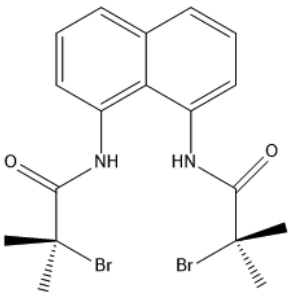
THANH VO

Faculty Mentor: Kim Lance
Department of Chemistry

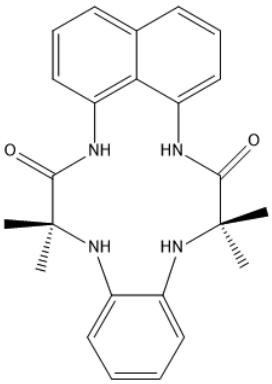
A common process to purify water for household use is oxidizing impurities by chlorination. This procedure, however, can produce various toxic by-products that are harmful to humans and the environment. In nature, iron-centered compounds achieve the same goal as chlorination without the unwanted side products. Following the principles of green chemistry, our research aims to obtain a complex that mimics the structure of these natural substances which can be used as an alternative procedure for water purification.

PREPARATION OF LIGAND SYSTEM FOR CATALYTIC COMPLEX

A procedure was developed for the preparation of a diamine — diamide macrocyclic ligand (DADA ligand). This was accomplished, in 15% yield, by dripping α-bromoisobutylryl bromide into a solution comprised of 1,8-diaminonaphthalene and triethylamine to yield the dibromide precursor of the intended ligand. The dibromide precursor along with o-phenylenediamine was then added to a solution of sodium hydride to form a reaction mixture. The DADA ligand was isolated as a solid product from the reaction mixture by column chromatography and solvent removal. NMR and MS spectral data confirmed identity of the targeted ligand, which would be metalated to yield the final complex capable of catalyzing oxidation in water.



The dibromide precursor



DADA ligand

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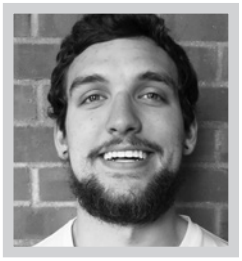

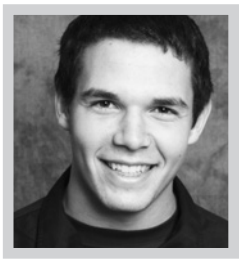

T.J. CLARK, TOM HORSFALL, JOHN PERANZI, AND YASMIN RADZI

Faculty Mentor: Jennifer R. Yates
Department of Psychology

There are currently 273,000 people in the United States living with the consequences of spinal cord injury. Methylprednisolone, the only drug currently approved for treatment of initial injury in humans, and 6-Chloro-Tryptophan, which isn't yet used in humans, are two drugs that can prevent the secondary damage after the initial spinal cord injury. We are studying whether the combination of these two drugs can more effectively block the post-injury decline in function in spinal cord injured guinea pigs than either treatment individually. Our early results show a successful reduction of these deficits in moderately injured guinea pigs, and if successful, our study could lead to improvements in future spinal cord injury research.

TREATMENT OF COMPRESSION SPINAL CORD INJURY IN GUINEA PIGS USING METHYLPREDNISOLONE AND 6-CHLORO-TRYPTOPHAN

Spinal cord injury is a debilitating condition which can cause severe loss of motor or sensory function in humans. This loss of function results from the primary deficits caused by the initial injury and the secondary deficits due to the pathological processes mediated by the inflammatory immune response. We studied the treatment efficacy of two drugs in combination to attenuate the secondary pathology of spinal cord injury in guinea pigs. Methylprednisolone (MP) is the only drug currently approved for acute spinal cord injury in humans. The administration of MP has been found in past research to lead to long-term motor and sensory improvements in spinal cord injured guinea pigs. The other treatment is 6-Chloro-Tryptophan (6-Cl-Tryp), which is not yet approved for human use. 6-Cl-Tryp is a precursor to 4-Chloro-3-hydroxyanthranilate, which has been found to reduce quinolinic acid production. This decrease in quinolinic acid accumulation reduces the secondary deficits of spinal cord injury in guinea pigs. To test the effects of the combination of these two drugs, we performed a lateral compression injury at thoracic level 12. The animals were divided into treatment groups using four combinations of MP and 6-Cl-Tryp or their vehicles. MP or its vehicle was administered at 60 mg/kg at 0.5 hours post-injury and at 30 mg/kg at 2, 4, and 6 hours post-injury. 33 mg 6-Cl-Tryp or its vehicle was administered at 5 hours post-injury, and then every 12 hours for 12 days. Functional deficits were quantified by simple motor and sensory tests such as proprioceptive placing, toe spread, and *cutaneus trunci* muscle response, and complex tests, such as incline plane, contact righting, and air righting. Our preliminary results indicate stronger trends in attenuation of moderate spinal cord injury in guinea pigs using 6-Cl-Tryp and MP.

Board 4

KHANH LE

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

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J. Doring; *Bundesamt fur Strahlenshutz*

The experimental confirmation/denial of pyramid-like shape, an exotic structure, in ^{70}Ge is important for our study of nuclear shapes and the development of theoretical models for nuclei. This research focused on measuring how fast nuclei can transition from one energy state to another. From those measurements, we can infer the distribution of protons inside the nucleus of ^{70}Ge which gives us a general idea of the nuclear shape of ^{70}Ge. Our experimental measurements will be compared with theoretical predictions in order to enhance our understand of nuclear structure.

SEARCH FOR TETRAHEDRAL SYMMETRY IN ^{70}Ge

The even-even Ge isotopes have recently become an active testing ground for a variety of exotic structural characteristics, including the existence of tetrahedral symmetry (pyramid-like shapes). Although theoretical shape calculations predict the onset of tetrahedral symmetry near ^{72}Ge, the experimental signatures (including vanishing quadrupole moments within rotational bands) remain elusive. This study searched for possible experimental evidence of tetrahedral symmetry in ^{70}Ge. Excited states in ^{70}Ge were populated at Florida State University using an ^{18}O beam at 50 MeV impinging on a ^{55}Mn target. Gamma rays depopulating the excited states were detected in coincidence with an array of 10 Ge detectors. The existing level scheme was enhanced through the addition of 20 new transitions and the rearrangement of 5 others based on the measured coincidence relations and relative intensities. Lifetimes of 24 states were measured using the Doppler-shift attenuation method, from which transition quadrupole moments were inferred. These results will be compared with those obtained from cranked Woods-Saxon calculations.

Board 5

HELEN DWYER

Faculty Mentor: Tami Panhuis
Department of Zoology

Placentas, though commonly associated with mammals, have evolved in a number of different organisms including sharks, lizards, and teleost fishes. The placenta is a site where substances are exchanged between mother and developing embryo and is predicted to be an arena of conflict between maternal-fetal genomes due to their asymmetry in relatedness. It has been observed that traits involved in areas of conflict are coevolving and may result in rapid evolution by positive selection such as seen in predator-prey and parasite-host interactions. Using genetic tools and molecular evolution analyses, we are studying a maternal protein, IGFBP1, expressed in the placenta of live-bearing teleost fish. This protein is predicted to interact with a rapidly evolving fetal growth protein at the maternal-fetal interface. We are investigating if IGFBP1 is rapidly evolving as predicted by the maternal-fetal conflict hypothesis.

MOLECULAR EVOLUTION OF IGFBP1 GENE IN *POECILIOPSIS* FISH

Conflicts between maternal and fetal genomes due to asymmetry in relatedness are believed to result in antagonistic coevolution of maternal and fetal interacting proteins. Many proteins involved in antagonistic coevolution have been shown to be rapidly evolving by positive selection (e.g. male reproductive proteins). We are investigating if the maternal binding protein IGFBP1 is rapidly evolving in live-bearing fish, *Poeciliopsis*. IGFBP1 is predicted to interact with the fetal growth protein IGF2 at the placenta maternal-fetal interface. IGF2 has been shown to be rapidly evolving by positive selection in *Poeciliopsis*; therefore, we predict that its interacting protein, IGFBP1, will also be rapidly evolving. We will sequence the IGFBP1 gene for seven *Poeciliopsis* species that differ in their level of placentation and potentially level of maternal-fetal conflict. In addition, we will add sequences from four closely related genera and 6 divergent fish species. The 17 aligned protein coding nucleotide sequences will be entered into the program PAML to compare the number of nonsynonymous (amino acid changing) substitutions to the number of synonymous (non-amino acid changing) substitutions (dN/dS). Having dN/dS values statistically greater than one will indicate rapid evolution by positive selection for IGFBP1. To date we have sequenced IGFBP1 from six of the seven *Poeciliopsis* species through amplification and cloning. Six amino acid changes across these sequences are encouraging of rapid evolution, however, definitive conclusions await the PAML analysis with all 17 sequences.

Board 6

JORDANE FAITH

Faculty Mentor: Laurie Anderson
Department of Botany and Microbiology

Our lab is studying garlic mustard, a plant that is invasive to North America. We are observing this species' growth and spread over time and how the species affects the diversity of the forest understory. Garlic mustard has been shown to have a negative effect on beneficial relationships between woody plants and fungi. We hypothesize that garlic mustard has a negative correlation with diversity in woody seedlings.

THE EFFECTS OF *ALLIARIA PETIOLATA* ON WOODY SEEDLING DIVERSITY IN A TEMPERATE DECIDUOUS FOREST

Alliaria petiolata is an herbaceous biennial plant that is invasive to North America. It releases allelopathic chemicals into surrounding soils which interrupt mychorrizal relationships that occur between woody plants and fungi. Some woody plants are thought to be highly dependent on these mychorrizal relationships, such as *Acer saccharum, Fraxinus americana,* and *Prunus serotina*. In this study a diversity survey was conducted on 1x1-m sections of 102 2x2-m plots in a new growth maple-beech forest from 2005 to 2014. The survey included collecting counts of all of the plant species present in the 1x1-m plot and counting the amount of garlic mustard in the entire 2x2-m plot. It was hypothesized that the abundance of woody species that are dependent on mychorrizal relationships would be negatively correlated to *A. petiolata* rosette abundance in the plots. *A. petiolata* rosette individuals were graphed using both a linear curve and a power curve against *A. saccharum, F. americana*, and *P. serotina* to describe the relationships. *F. americana* abundance was not shown to be significantly correlated to *A. petiolata* rosette abundance when described by a linear curve ($p=0.6117$) or a power curve ($p=0.190$). *P. serotina* abundance was also not shown to have a significant correlation to *A. petiolata* rosette abundance when described by a linear curve ($p=0.1019$) or a power curve ($p=0.059$). *A. saccharum* abundance did not show a significant correlation to garlic mustard when the linear curve was used ($p=0.1995$). When a power curve was used to describe the relationship there was a significant negative correlation between *A. saccharum* and *A. petiolata* that accounted for 5% of the data variability ($p=0.004$). This seemingly low effect on seedlings that are dependent on mychorrizal relationships suggests that *A. petiolata* may not be as devastating to understory diversity as has been previously predicted.

Board 7

RYAN STEFANCIK

Faculty Mentor: Dave Markwardt
Department of Zoology

A process called NMD stops a cell from making incorrect proteins that are made as a result of what are essentially "proof-reading" errors. It is thought that there are very tiny molecules called polyamines in cells that let these errors get past NMD by stabilizing the templates with the errors, and let the cell make incorrect proteins. If these defunct proteins are made, they can be harmful to the cell and the organism. By controlling the polyamines available to cells, and their ability to perform NMD, we are trying to see which proteins are made by the polyamines masking the templates from NMD.

POLYAMINE-DEPENDENT CONTROL OF mRNA STABILITY IN *SCHIZOSACCHAROMYCES POMBE*

All eukaryotic cells create (and take up from their environment), small, positively charged molecules called polyamines that are involved in a large number of cellular processes, including: signal transduction, functioning of ion channels, and mRNA stabilization. The molecular mechanism that allows polyamines to control mRNA stability is not known. In this project we are asking whether polyamines determine the stability of select RNAs by targeting them to (or masking them from) an RNA destabilization pathway called nonsense-mediated decay (NMD). NMD is an RNA surveillance system that targets and degrades mRNA transcripts with sequence features often associated with transcriptional errors. Polyamines may bind to normal RNAs and alter their conformation in a way that hides or reveals these NMD-trigger sequences. In order to see whether polyamines can control the stability of specific transcripts, we will be knocking out genes that code for NMD proteins and polyamine biosynthetic enzymes in our model organism, the fission yeast *Schizosaccharomyces pombe*. To stop polyamine production in our yeast cells, we will be knocking out the SPE1 gene that codes for an enzyme required for polyamine production. By knocking out this gene, we will be able to control their exposure to polyamines in their growth media, since yeast can take up polyamines from the extracellular environment. To eliminate NMD, we will be knocking out the UPF2 gene, which codes for a protein that is necessary for the process. Using this "double-knockout", we will be able to measure the polyamine and NMD-dependent effects on mRNA stability. This summer we have been working on creating strains of yeast with the necessary gene disruptions, and will begin gathering data this coming school year.

Board 8

MADELINE VROOM

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

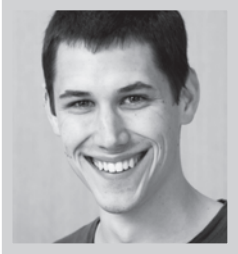
Preen oil is produced by birds and spread across their feathers to protect them from feather-damaging bacteria, such as *Bacillus*. The thickness of the oil may function as a physical barrier that prevents the bacteria from swimming to areas of breakage in the feathers and causing greater destruction. We know that *Bacillus* bacteria swim toward proline, a chemical found in feathers, and we want to investigate whether movement of the bacteria is inhibited in a thicker medium that mimics preen oil. Our research may help reveal how preen oil functions, which is currently a topic of debate.

CHARACTERIZATION OF THE MOTILITY AND CHEMOTAXIS OF *BACILLUS* SPP. ISOLATED FROM SONGBIRD PLUMAGE

Bacillus spp. isolated from the microbial ecosystem of songbird plumage are motile bacteria known to utilize feathers as a source of nutrients by degrading the protein β-keratin. The preen oil birds distribute across their feathers is thought to provide protection against feather-degrading bacteria although it is unclear in what capacity it does so. Preliminary data suggest that the viscosity of preen oil may function as a physical barrier against chemotaxis of *Bacillus* towards areas of feather damage where amino acids are available, thereby preventing further feather deterioration. We studied feather-degrading *Bacillus* spp. Isolated from songbird plumage to characterize their motility and chemotactic response to amino acids from β-keratin. Growth curves and motility assays were performed on *Bacillus* isolates with high motility (>50% of cells motile). With 75% motility and a generation time of 3.32 hours, *Bacillus* isolate 4201TV was chosen for chemotaxis assays using modified Palleroni chambers to quantify the chemotactic response of 4201TV to proline. Our findings indicate that *Bacillus* spp. are chemotactic towards 250 μM and 750 μM proline based on the response ratios of 2.76 and 7.6, respectively, with a ratio greater than 2.0 indicating a positive chemotactic response. Future studies are aimed at characterizing the chemotactic response of *Bacillus* towards amino acids other than proline present in β-keratin and elucidating the possible connection between the chemotaxis of *Bacillus* spp. and the use of preen oil.

Board 9

DOUGLAS B. GIBSON



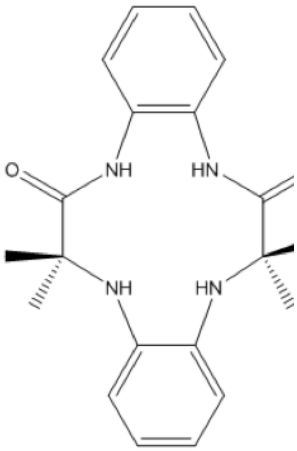
Faculty Mentor: Kim Lance
Department of Chemistry

We attempted to synthesize molecules that would purify water in a safe and clean way. These would improve upon modern methods and improve worldwide access to clean water.

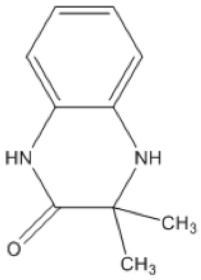
ATTEMPTED SYNTHESIS OF 7,7,14,14-TETRAMETHYL-5,7,8,13,14,16-HEXAHYDRODIBENZO[*b,h*][1,4,7,10] TETRAAZACYCLODODECINE-6,15-DIONE FOR USE AS AN OXIDATION CATALYST IN WATER PURIFICATION

Multiple attempts were made to synthesize a diamine-diamide macrocycle (I), all of which were unsuccessful. In each attempted reaction scheme there was a ring closure that prevented the macrocycle from forming. The product of unwanted ring closure was the same byproduct (II) in each reaction scheme, produced in varying yields for each scheme. The bryproduct was confirmed using 1H and 13C NMR, infrared spectroscopy and solid state mass spectroscopy.

(I)



(II)



Board 10

JAYNE ACKERMAN AND DARA MARKUS

Faculty Mentor: Chris Wolverton
Department of Botany and Microbiology

Starch is important for gravity sensing in plants. When a plant is moved away from its original orientation these starch filled packets move and a hormone (auxin) moves, allowing the plant to curve back to its original position. Starchless plants were used to test the difference in response rate (how quickly the root curves) and auxin distribution within the primary roots at different angles of constraint. Another experiment focused on lateral roots' auxin distribution and angle variation after being held at a 45° angle for 1-3 hours then rotated to counteract unidirectional stimulation for 1 hour.

ROOT GRAVITROPISM AND AUXIN DISTRIBUTION IN ARABIDOPSIS

Gravitropism is a gravity directed growth process experienced by roots and shoots. Arabidopsis root structure consists of primary and lateral roots which respond differently to gravitropic stimulation. These roots perceive gravity by the movement of starch-filled amyloplasts and respond by auxin-induced cell elongation, allowing for curvature. We are interested in how starch statolith sedimentation and auxin flux are related in shaping the overall root system. Previous work in this lab has shown that roots without starch statoliths fail to produce auxin gradients. We have used a long term feedback system to provide a more rigorous test of auxin gradient formation in roots lacking statoliths. Roots were constrained at 30° (low) and 120° (high) and failed to produce auxin gradients, consistent with previous results. To test for auxin gradient formation in lateral roots, root systems were stimulated 45° from the upright position and then placed on a clinostat for a period in order to minimize further unidirectional gravity stimulation. Results are still being analyzed, but preliminary data suggest that auxin gradients are visible within the cap as early as 1 h after stimulation. This suggests that the auxin gradient forms and rapidly dissipates during the growth response. The data presented here suggest that auxin and auxin transport are highly dynamic in the root, and play key roles in growth regulation.

Board 11

MEGAN BUYS

Faculty Mentor: Melanie Henderson
Department of Psychology

Our research looks at Identity Integration (seeing traits and obligations of multiple roles as either conflicting or compatible), specifically the roles of supervisor and friend in the workplace. We presented participants with a story about a fictitious employee causing trouble and then asked them to act as the supervisor in their responses. Some of these participants were further manipulated, either to see being both a supervisor and a friend as a compatible, and a good thing, or to see these roles as conflicting, and thus being only one as a good thing. We hope to show that the ability to be both a supervisor and a friend can be manipulated to help facilitate more effective role conflict management in organizational settings.

BEING BOSSY AND BEING FRIENDLY: THE EFFECTS OF IDENTITY INTEGRATION ON ROLE CONFLICT MANAGEMENT

This study examines the psychological processes that underlie how conflicting roles are managed within organizational settings, and how these processes affect the use of behavioral and verbal power strategies. Research on social identity integration has examined this construct as an individual difference where multiple social identities are viewed as harmonious or conflicting. While roles have been explored in relation to stable social identities, including racial/ethnic, gender, cultural, and sexual identities, and recent work has begun to incorporate multiple domains such as work and family, the current study aims to extend the literature to encompass dynamic roles within a single domain—the workplace. In addition to measuring identity integration as a stable, individual difference in perceived compatibility among social identities, this line of research also experimentally manipulates identity integration ideals to explore identity integration as a process that has the potential to be malleable. Study 1 will use a correlational design to examine how Identity Integration (II)—perceived compatibility between conflicting obligations arising from multiple identities/roles—affects behavioral and verbal power tactics under the organizational role conflict of "supervisor" and "friend." Study 2 will use an experimental design to manipulate high II, low II, or no II ideals and explore the effects of II on responses to the same organizational role conflict. These studies hypothesize that compared to low II, high II will be associated with more integrative behavioral tactics and more polite verbal tactics, which combine power and affiliation obligations. Furthermore, by manipulating II, this research will explore whether II can be changed to facilitate effective role conflict management in organizational settings.

Board 12

DOMINIQUE BERRY, FLORIDA A&M UNIVERSITY

MARK CHALMERS, OHIO WESLEYAN UNIVERSITY

JOSH DENISON, OHIO WESLEYAN UNIVERSITY

DON STEVENS, OHIO WESLEYAN UNIVERSITY

KAYLEE YUHAUS, BALDWIN WALLACE UNIVERSITY

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

Starspots are cooler, darker regions that appear on the surfaces of magnetically active stars such as our Sun. By studying how spot patterns change on such stars, the scientific community attempts to gain a better understanding of the inner workings of our own Sun's magnetic field, possibly allowing us to better predict such its future behavior. By observing the varying brightness of the star LO Pegasi, which is due to its large starspots being carried into and out of view of Earth by the star's rotation, we have construct images of these spots using a computer technique known as Light-curve Inversion.

STAR SPOTS ON LO PEGASI, 2006-2014

Stars of spectral types F through M can exhibit dark spots on their surfaces, which are magnetic active regions analogous to sunspots on the Sun. The dark spots cause the star's brightness to vary as they are carried into and out of view by the star's rotation. Light curves of the star LO Pegasi obtained through standard B, V, R and I photometric filters from 2006-2014 were used to study the evolution of spots on its surface over time. A computational technique known as Light-curve Inversion (LI), developed by Robert Harmon, was used to produce surface maps of the star from its brightness variations. LI involves dividing the surface of the star into equal-area patches and making the assumption that each patch is uniformly bright across its face, and then determining the set of patch intensities that produces the "smoothest" surface such that the RMS residual between the calculated and data light curves is equal to the estimated noise in the data. The constraint on the residual is needed to avoid artifacts from appearing in the surface reconstructions caused by attempting to fit the noise in the data. We also performed a detailed period analysis on the entire data set using the ANOVA method to search for variations associated with differential rotation. No evidence of period change was found, as the periods for each year were equal to within their uncertainties. For the data set as a whole, the period of rotation was determined to be 10.1538 ± 0.0009 hr, which is in agreement with previously published results.

Board 13

KRISTEN ELYSSE ASTORIAN

Faculty Mentor: Laurie Anderson
Department of Botany and Microbiology

Garlic Mustard (*Alliaria petiolata*) is an invasive plant that dominates new ecosystems by driving out native species. Previous, unpublished research has found a difference between the size and relative number of garlic mustard between urban and rural sites, however little is known about whether these populations are also distinctive genetically. I hope to use the potential differences in non-coding regions to see if the garlic mustard are genetically different based on environment type, specific location or relative size.

COMPARISON OF *ALLIARIA PETIOLATA* GENETICS, LEAF SIZE AND ENVIRONMENTAL CONDITIONS IN URBAN VERSUS RURAL ENVIRONMENTS

Alliaria petiolata (garlic mustard) is an introduced, biennial herbaceous species that is of great concern to ecologists because it has been shown, like other invasive plant species, to reduce diversity of understory plants through several mechanisms. *A. petiolata* colonizes a range of habitat types, and we were interested in comparing various *A. petiolata* traits in woodland fragments located in urban vs. rural landscapes. Little is known about the genetic characteristics of urban and rural populations. Previous genetic research concerning this plant has shown that *A. petiolata* has a high rate of self-pollination which would imply that individual populations may be genetically distinct or that the original populations colonizing from Europe underwent a strong genetic bottleneck. In addition, other work has shown that urban and rural sites can have environmental differences that can create different selection pressures leading to genetic differences. Using eight microsatellite regions isolated by Durka et al (2004) for *A. petiolata*, we attempted to genetically differentiate individuals between urban and rural populations. I hypothesized that individuals from urban environments will be genetically distinct than those from rural environments in the 8 microsatellite regions isolated. We collected four individuals from each of six sites, extracted and amplified DNA fragments and used gel electrophoresis to examine band patterns to determine potential genetic differences. Atmospheric CO_2 was measured at each site as were soil moisture, soil pH and number of seeds per silique. Finally, 20 leaves from each site were measured and compared. Soil pH and leaf size showed statistical differences; leaves were larger in urban environments and urban soils had higher pH. Atmospheric CO_2, soil moisture, and number of seeds per silique were not statistically different between site types. These data indicate the presence of some environmental and phenotypic differences in *A. petiolata* populations in urban and rural sites. Our ongoing work will determine if genetic differences exist as well.

Board 14

ALEXANDER D. LANDGRAF

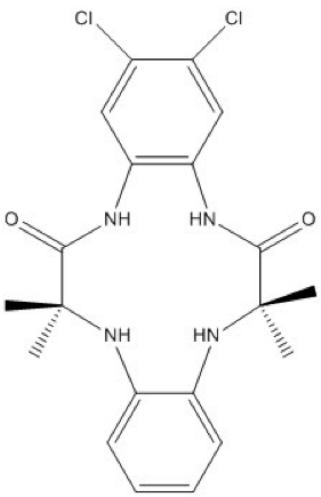
Faculty Mentor: Kim Lance
Department of Chemistry

We are attempting to synthesize a molecule that will help improve the efficiency of large scale water treatment. These molecules where developed to mimic an enzyme in the body known as cytochrome P450, which is responsible in breaking down toxins. These molecules could modify the current water treatment process and allow more people access to clean water around the world.

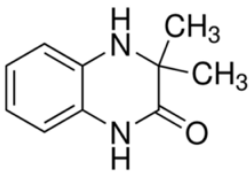
ATTEMPTED SYNTHESIS OF 2,3-DICHLORO-7,7,14,14-TETRAMETHYL-5,7,8,13,14,16-HEXAHYDRODIBENZO[b,h][1,4,7,10] TETRAAZACYCLODODECINE-6,15-DIONE FOR USE IN CATALYTIC OXIDATION

Synthesis of a 12 member diamine-diamide macrocycle(I) was found to be unsuccessful using various reaction schemes. Macrocyclic ring closure of a dibromide diamide with a diamine was found to be less favorable then an unpredicted intramolecular ring closure. The ring closure resulted in the formation of a byproduct 3,3-dimethyl-3,4-dihydroquinoxalin-2(1H)-one(II). The byproduct was formed with a 31% yield and was characterized by IR, proton NMR, carbon NMR, and solid state mass spectroscopy. All spectral results were consistent with the formation of the byproduct.

(I)

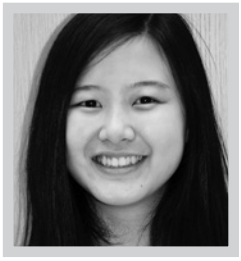


(II)



Board 15

THIN NU YEE, KAITLYN KROPF AND KATIE SWINDLER



Faculty Mentor: Lynda Hall
Department of Psychology

We're studying how perception of aging influences memory across cultures, specifically in Ohio and Myanmar. We measure memory via immediate and delayed recall and recognition tasks. These tasks are separated by surveys intended to gauge cultural views on aging and cognition changes during the aging process.

PERCEPTION OF AGING AND MEMORY PERFORMANCE IN OLDER ADULTS IN THE U.S. AND MYANMAR

Past research comparing Western and Asian communities has demonstrated differences in cultural attitudes about aging. Furthermore, studies conducted in Western cultures have correlated negative stereotypes about aging with poorer memory performance in older adults. This study will examine differences in the beliefs about aging in the U.S. and Myanmar. The memory performance of the participants was assessed to determine if cultural stereotypes have a similar relationship to memory performance in both countries. All participants were given a demographic questionnaire and three measures of attitudes towards aging. Cognitive performance was assessed with three nonverbal tasks; participants were giving two visual reproduction tasks (to measure episodic memory) and a cross out task (to measure memory processing speed). We hypothesize that the older adults in Myanmar will have more positive beliefs about aging than the U.S. older adults and these beliefs will be correlated with higher memory performance scores.

Board 16

EMILY JOHNSON

Faculty Mentor: Jed Burtt
Ohio Wesleyan University, Department of Zoology

The European Nuthatch (*Sitta europaea*) is a bark foraging species of bird, commonly found in both urban environments and forests. Nuthatches cache food to be eaten later. The characteristics of trees used for caching or foraging activity in urban versus forest environments in Cologne and Kottenforst, Germany were compared, showing a preference for oaks (*Quercus spp.*) and European beeches (*Fagus sylvatica*).

COMPARISON OF FORAGING BEHAVIOR OF EUROPEAN NUTHATCHES (SITTA EUROPAEA) IN URBAN AND RURAL AREAS OF GERMANY

European nuthatches (*Sitta europaea*) living in city parks in Cologne and in the Kottenforst outside Bonn, Nordrhein-Westfalen, Germany, preferred oaks (*Quercus spp.*) of several species and European beeches (*Fagus sylvatica*) respectively. Nuthatches forging in urban parks were less selective about the texture of the bark, its rugosity, and the maturity of the trees, as estimated from the diameter at breast height, than those in the more natural Kottenforst. Because European Nuthatches foraged on several species of trees their preference for areas with a high diversity is not surprising. This accounts in part for the greater density of nuthatches in Kottenforst than in the city parks, but it also suggests how the density of nuthatches in city parks might be increased. The importance of the conclusions of this simple study for the future health of populations of European Nuthatches will be discussed briefly.

Board 17

JUSTIN BELLASSAI

Faculty Mentor: Natalia Tararova
DAPCEL Inc., Product Development

The ability to obtain accurate and precise data regarding the amount of a specific protein present in a sample is a very important tool for researchers in cell and molecular biology. A common technique employed to accomplish this is called sandwich ELISA. A large family of proteins which researchers often measure using this technique are the cytokines (proteins that cells use to communicate with one another). This summer our lab continued development of a new high fidelity kit that will allow researchers to detect a human cytokine called IL-35 using sandwich ELISA. Using murine immune cells along with recombinant DNA technology we hope to create a kit that is both highly sensitive and highly specific for human IL-35.

DEVELOPMENT OF AN AFFORDABLE HIGH FIDELITY SANDWICH ELISA KIT FOR HUMAN IL-35

Sandwich ELISA is an assay technique commonly employed to provide a quantitative measure of the amount of a specific target protein present in a sample. ELISA kits are available from many different companies for assaying hundreds of different proteins. However, offerings for hIL-35 are limited in comparison to other interleukins, and can be very expensive when offered. This is due to difficulties present in the engineering of capture and detection antibodies due to hIL-35's nature as a dimer of hIL-12α and hIL-27β subunits. This causes antibodies raised against hIL-35 to oftentimes cross react too heavily with hIL-12 and/or hIL-27 to be useful for ELISA. Our antibodies are produced by murine B cells which have been immunized against hIL-35 and fused to myeloma cells. Western blot analysis along with direct ELISA shows that our antibodies are capable of binding hIL-35 without binding to hIL-27 and with minimal binding to hIL-12. This suggests that these antibodies could be successfully utilized in a sandwich ELISA assay for hIL-35. Our next phase of development is focused on determining the lower detection limit of these antibodies for hIL-35 and which of them work well for capture and/or detection.

Board 18

SHANE GORBETT

Faculty Mentor: Shala Hankison
Department of Zoology

We are studying aspects of sperm quality in mice selectively bred for high voluntary wheel running to determine the effects of endurance exercise on male fertility. To do this we are analyzing the sperm of these mice to look for common abnormalities which are known to impair natural reproduction. If high runner mice have significant differences in sperm quality, such as morphology, motility, and number, relative to the control group, then it is possible that endurance exercise negatively effects male fertility. This study will contribute to our understanding of the relationship between endurance exercise and sperm viability in mammals.

IMPACT OF MALE: FEMALE RATIO ON MALE MATING BEHAVIORS IN *POECILIA LATIPINNA*

Studies on intersexual mating competition show that an increase in the proportion of males leads to increased male-male aggression and decreased courtship. Mating behaviors of the U.S. sailfin molly (*Poecilia latipinna*) have been studied in depth, however primarily in a 1:1 male:female ratio. We hypothesized that in a more female biased ratio males would exhibit a higher frequency of female-oriented mating and courtship behaviors and in more male biased ratios males would demonstrate a decrease in courtship behaviors and mating frequency and an increase in male competition. We observed male *P. latipinna* in four differing male:female ratios of 1:1,1:5, 2:4, and 3:3 for courtship and competition behaviors. As predicted, males perform more courtship behaviors, including nibbling, and spend more time courting when they are the only present male and when there are more females to whom to direct courtship behaviors. Surprisingly, males performed a varying number of thrusts across the social ratios. Males in more male biased groups showed slightly, but not significantly, more aggression and competition behaviors (eg. male-male displays, biting, mate guarding) compared to males in more female biased environments, suggesting that there may be a threshold for the benefits of competition and these behaviors may be maintained at a relatively constant level. However, the overall pattern suggests that males are dividing their time between courtship and competitive behaviors, with approximately equal time spent displaying overall whether it be to females or males. This study demonstrated that in a social environment with an increased proportion of competitors male *P. latipinna* put less time and energy into courtship displays and nibbling behaviors directed at females, and more time and energy into competing with other males, but that thrusting, a behavior that potentially can pass sperm to the female, did not change.

The U.S. sailfin molly (*Poecilia latipinna*) generally lives in large, schooling groups, but mating behaviors have primarily been studied in depth in isolated male-female pairs. While these studies can demonstrate mating behaviors and allow comparisons across populations, they lack the ability to provide understanding into what is happening in nature, an important consideration to understanding how the species may evolve and differentiate. In this study, I focused on how a social environment would influence and change the mating behaviors of male sailfin mollies. I observed males in three differing male:female ratios (1:5, 2:4, and 3:3) for courtship, and competitive behaviors. I hypothesized that when there was relatively more females, males would perform more mating and courtship behaviors. Conversely, when there were relatively fewer females, males would exhibit less mating and courtship behaviors and more competitive behaviors. In more male biased environments males perform more male competition behaviors because the males must compete more vigorously for the few available females. This study demonstrated that in a more male biased social environment male sailfin mollies put less time and energy into female oriented behaviors because more time and energy was spent competing with other males for the low availability of female mates. An overall pattern indicated that males divided their time between courtship and competition with equal time spent displaying overall, whether to females or males.

Board 19

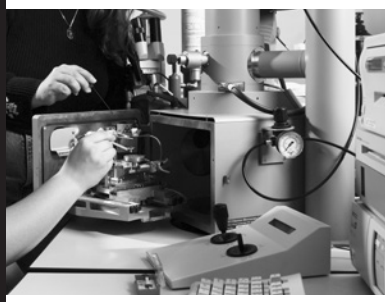
SHANE GORBETT

Faculty Mentor: Shala Hankison
Department of Zoology

Studies on primate social behavior show that individuals prefer to participate in friendly interactions such as grooming, resting, and feeding with related individuals. However, recent studies suggest that familiarity with individuals, not genetic relatedness, is the main determinant for primate social interactions. In addition while most studies on juvenile social behavior have focused on primates living in large groups, this study investigated *Propithecus edwardsi*, Milne-Edwards' sifaka, a primate that lives in small groups of only 3-8 individuals. I observed two female juvenile Milne-Edwards' sifaka in two different groups, one group consisting entirely of related individuals and one group consisting of a combination of related and non-related individuals. As predicted, the juveniles spent more time in close proximity performing more resting and feeding behaviors with related individuals, although the relationship was not statistically significant. Additionally, related individuals displayed a more symmetrical relationship than non-related individuals with both individuals equally initiating social interactions. However, more time was spent grooming with a non-related adult female, which could have been caused by the presence of an infant or the younger juvenile learning sex-typical behaviors from the only adult female present. Although this preliminary study did not yield statistically significant results, the data suggest that a long-term study with a larger sample size on the juvenile and social behavior of Milne-Edwards' sifaka could provide valuable information on the effect of genetic relatedness and familiarity on primate social behavior in smaller group compositions.

EFFECT OF GROUP COMPOSITION ON SOCIAL BEHAVIOR OF JUVENILE *PROPITHECUS EDWARDSI* (MILNE-EDWARDS' SIFAKA) IN RANOMAFANA NATIONAL PARK, MADAGASCAR

In many primate species individuals show preferential affiliation for kin for friendly interactions such as grooming, contact resting, and co-feeding. Recent studies, however, suggest that familiarity, not genetic relatedness, is the driving factor for social interactions. For example, the effect of kinship on juvenile primates social behavior has been studied, however, studies have primarily been in species with large group compositions that consist of multiple individuals with varying relatedness and many that share no genetic relatedness. The aim of the study was to obtain data on the effect of kinship and group composition on the social behavior of juvenile *Propithecus edwardsi*, a primate that lives in small group compositions. I observed two female juvenile P. edwardsi in two separate groups, one group consisting entirely of kin and the other a mixture of kin and non-kin, using continuous focal animal sampling for social behaviors. The juveniles spent more time in close proximity with kin performing more contact resting and co-feeding behaviors with kin, although the data were not signifiant. In addition, related individuals displayed more symmetrical relationships with each member of the dyad exhibiting responsibility for initiating social interactions. Unexpectedly, more time was spent in grooming behaviors with a non-related adult female, which could have been caused by various factors including the presence of an infant in one group or the age difference of the two focal juvenile *P. edwardsi.* Although this preliminary study did not yield statistically significant results, the trends in the data suggest that a long-term study with a larger sample size on the juvenile and social behavior of *Propithecus edwardsi* could shed light on the effect of kinship on primate social behavior in smaller group compositions.




Board 20

NIVEDITHA MANIVANNAN

Faculty Mentor: Herbert DuPont
University of Texas School of Public Health, Houston, TX,
Department of Infectious Diseases

Clostridium difficile infection (CDI) causes diarrhea and severe intestinal inflammation and it mostly occurs in elderly patients who have taken multiple rounds of antibiotics. Antibiotics reduce the diversity of bacteria that is naturally present in the gut. Fecal microbiota transplantation (FMT) is used to restore the bacteria in the colon of recurrent CDI patients because gut microbes help resist *C.difficile* colonization. We were interested in seeing if FMT reduced the inflammatory response in patients with CDI. We found that after FMT, patients had a decreased concentration of one type of inflammatory marker.

COLONIC INFLAMMATION IN RECURRENT CDI PATIENTS TREATED WITH FECAL MICROBIOTA TRANSPLANTATION

Clostridium difficile infection (CDI) is the most common healthcare associated infection in the U.S. Release of toxins by *C.difficile* causes acute mucosal inflammation. Recurrent CDI is due to a reduction in diversity of flora in the colon and a weakened response to *C.difficile* colonization. Fecal Microbiota Transplantation (FMT), implantation of normal bacteria from a healthy donor, restores the colonic flora diversity and is an effective treatment of recurrent CDI. We hypothesized that FMT will lead to a reduction and normalization of inflammatory response in patients with multiple recurrences of CDI. We used quantitative ELISA to determine the fecal concentration of IL-23, IL-13, IL-8, lactoferrin and calprotectin in pre-FMT, 7-day post-FMT, 30-day post-FMT stool samples in 21 patients with recurrent CDI undergoing FMT, and in donor (control) stool samples. IL-13, IL-8 and calprotectin concentrations were not elevated ($p>0.05$) in the pre-FMT patient stool samples. Fecal IL-23 and lactoferrin concentrations were significantly higher ($p<0.05$) in the pre-FMT stools compared to the control group. Lactoferrin levels remained elevated in patients throughout the 30-day post FMT study indicating the persistence of the inflammatory response. IL-23 levels decreased significantly ($p<0.05$) and normalized within a week after FMT, correlating with recovery from CDI. IL-23 needs further study as a correlate with CDI recovery and as a possible therapeutic target for the treatment of CDI.

Board 21

COURTNEY FOX

Faculty Mentor: Denise Adams
Cincinnati Children's Hospital Medical Center and The University of Cincinnati Medical School, Department of Hematology/Oncology

Vascular malformations, such as Blue Rubber Bleb Nevus Syndrome (BRBNS), are very rare abnormalities of blood vessels present at birth. These lesions can occur in various locations internally and externally and can cause many secondary medical issues. This study reviewed medical charts of patients with this specific type of abnormality and found that patients treated with the medication Sirolimus showed significant positive improvements with their condition and overall health.

RESPONSE OF BLUE RUBBER BLEB NEVUS SYNDROME (BRBNS) TO SIROLIMUS

Vascular malformations are very rare congenital abnormalities of the blood vessels. They can affect the veins, arteries, capillaries, and/or the lymphatic channels. These lesions are benign and can be located anywhere internally or externally. Blue Rubber Bleb Nevus Syndrome (BRBNS) is a type of vascular malformation that can occur in the soft tissues, skin, and the gastrointestinal tract (GI), and various other locations. Patients with this diagnosis are at a risk of secondary anemia, internal bleeding in the GI tract, pain, and coagulopathies. Due to the highly risky and sometimes ineffective nature of previous surgical procedures for patients with BRBNS, better options are being explored to effectively treat patients. This research was a retrospective medical chart review of the small population of patients seen at Cincinnati Children's Hospital Medical Center with the complex diagnosis of BRBNS. Our hypothesis was Sirolimus (Rapamycin or Rapamune) can effectively treat the symptoms and sequelae of BRBNS. It can also be seen that the lesions were greatly diminished in size and number and there was a significant increase in the quality of life of these patients. Sirolimus presents with limited side effects and dramatically decreases the need for invasive surgeries and blood transfusions for patients diagnosed with Blue Rubber Bleb Nevus Syndrome.

Board 22

KYLE A SIMON

Faculty Mentors: Konstantin O. Tskhay and Nicholas O. Rule
University of Toronto, Department of Psychology (Social Perception and Cognition Lab)

Understanding how we perceive individuals is important because of how often social perception affects our everyday lives. By researching the phenomenon known as "gay-dar" we can further elucidate how people perceive social groups without physical cues (ex. racial groups) and how emotions affect these perceptions. Our lab focused on how the emotions of fear and disgust affected the perception and categorization of gay males. By asking participants to pose these emotions we found that individuals, who have a higher tendency to categorize others as straight, have a decreased accuracy when posing a fearful face.

THE INFLUENCE OF EMOTIONAL EXPRESSION ON THE CATEGORIZATION OF SEXUAL ORIENTATION

Previous studies have demonstrated that people perceive sexual orientation with accuracies that exceed chance guessing. Furthermore, previous research has demonstrated that sexual orientation is associated with emotions such as fear and disgust. From an evolutionary standpoint, both of these emotions facilitate sensory acquisition. Thus, in the current study, we examined how these emotional expressions might affect the perception of sexual orientation. The results demonstrated that those participants who had a tendency to categorize targets as straight had diminished categorization accuracy when they were expressing fear. We found no similar effects for the participants who had a tendency to categorize others as gay.

Board 23

KYLE DAVIS

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

I gathered 100 feathers from Tree Swallow nests. These feathers were taken from five different stages of the nesting cycle of the Tree Swallow. I then cut 1 centimeter off the top of each feather and placed them in sterile saline. This step was done to knock off the mold, fungi, and bacteria. I would then place the saline solution on five different plates. The plates were incubated for 48 hours. Once they had incubated, the bacteria were identified by colony morphology, and by the media they grew on. This data showed that bacteria, mold, and fungi in the feathers did increase in the later stages of the nesting cycle.

FEATHER MICROBIOTA IN TREE SWALLOW (*TACHYCINETA BICOLOR*) NESTS

The microbiology of avian plumage has been studied in adults (Burtt, J. Avian Biol. 40:349-351. 2009, Burtt and Ichida. Auk 116:364-372. 1999, Gunderson Auk 125:972-979. 2008.), but the microbiota of feathers used to line the nests of birds has not been described. I collected feathers from the nests of Tree Swallows (*Tachycineta bicolor*) from five different stages in the swallow nesting cycle beginning when the swallows first added feathers to their nest, when they laid their first eggs, when incubation started, when the first chick hatched, and when the nestlings fledged. Two feathers were collected from each nest at each stage, 100 feathers in total. The bacteria were removed from the feathers in nutrient broth and samples of the broth were cultured on selective media. The colonies of bacteria were then identified by colony morphology and the media on which they grew. Microbial diversity and abundance were greater in the later stages of the nesting cycle than in the earlier stages, as expected. This is shown through the four bar graphs I generated.

Board 24

SARA SCINTO

Faculty Mentor: H. Peter Spielmann
University of Kentucky, Department of Molecular and Cellular Biochemistry

Isoprenoids are molecules made up of a chain of 5 carbon units essential for the correct function of cells in plants and animals. Previous research has found that synthetic isoprenoids can compete with natural isoprenoids to alter an enzyme's function by serving as an alternative molecule for enzymes to act on. My first project involved treating a tobacco plant enzyme with chemically similar synthetic structures of the natural molecule it normally cyclizes to determine if the enzyme would form novel, 13 membered rings with the unnatural isoprenoids. My second project involved making synthetic isoprenoids that help prevent the metastasis of aggressive breast cancer cells by competing with natural isoprenoids in the cellular mechanisms that allow the division cells. Results suggested the tobacco plant enzyme cyclized multiple synthetic structures to create unusual molecules that could lead to drug discovery. The isoprenoids for the second project were successfully synthesized, but have yet to be tested on cells or in mammalian models.

SYNTHETIC ISOPRENOIDS THAT ALTER ENZYME FUNCTION

Isoprenoids are a class of molecules composed of 5 carbon isoprene units essential for many cellular mechanisms and found in abundance in living organisms. Research has found that synthetic isoprenoid analogs in which an aniline ring replaces one isoprene unit can serve as alternative substrates for enzymes that utilize natural isoprenoids. Tobacco 5-epiaristolochene synthase (TEAS), which normally catalyzes a cyclization reaction with the natural isoprenoid farnsyl pyrophosphate (FPP) to form the stereospecific bicyclic ring (+)-5-epiaristolochene, also cyclizes synthetic analog aniline-geranyl pyrophosphate (AGPP) to form a novel, 13-membered ring. This summer, AGPP analogs were tested with TEAS and products were characterized by mass spectrometry. Data suggested 4 out of the 15 tested analogs did cyclize, while the other 11 molecules either had a blocked para position on the ring, were too big to fit in the enzyme pocket, or possessed a deactivated ring. In the future, the cyclized products may be further chemically modified into useful molecules because of their novel structures. Previous research has also shown the synthetic analog aniline farnseyl alcohol (AFOH) impedes the invasive growth of aggressive breast cancer cells by preventing the oncoprotein Rho from binding to the cell membrane and becoming functional. Rho is normally isoprenylated with a geranyl geranyl unit, but AFOH serves as an alternative substrate for prenyl transferases and is added to the terminal cysteine of Rho instead of the natural isoprenoid. AFOH is very effective in 2D and 3D cell cultures, but it is metabolized quickly in mice models, so this summer, 3 AFOH analogs were synthesized from *trans*, *trans*-farnesyl acetate via oxidation, reductive amination, and saponification steps and characterized by NMR spectrometry. The analogs contained a modified aniline ring with a trifluoromethoxy group, chlorine, or fluorine placed at the para position, the proposed site of metabolism. Cell culture experiments will be conducted to determine if the analogs are more efficient at inhibiting metastasis and resisting metabolism.

Board 25

NICHOLAS FOWLER

Faculty Mentor: David Stroncek
National Institutes of Health, Department of Transfusion Medicine

Allogeneic stem cell transplantation can cure cancer but also can be lethal due to immune T cell attack against normal tissue (this attack is termed "graft-versus-host disease" or GVHD). Clinical trials have identified that different types of T cells infused with the transplant were associated with either a high or low rate of GVHD. Because it is critical to understand why a specific T cell might cause GVHD, we measured the expression of all known human genes (36,000) in each T cell that was infused. We found that T cells that caused more GVHD had a clearly identifiable gene signature, thus indicated future directions to improve transplant therapy.

IDENTIFICATION OF A T CELL MOLECULAR SIGNATURE FOR GRAFT-VERSUS-HOST DISEASE

Allogeneic stem cell transplantation (SCT) can cure cancer such as leukemia and lymphoma but is limited in part by immune attack against normal tissues, which can cause lethal, inflammatory graft-versus-host disease (GVHD). In clinical trials at the National Institutes of Health (NIH), investigators have been evaluating specialized T cell infusions that attempt to cure patients with less GVHD. Such T cells were manufactured in the immune-modulation drug rapamycin for either 12 (T-R12; n=40) or 6 days (T-R6; n=40); these T cell products were associated with GVHD rates of either 10% or 40%, respectively. Using micro-array gene expression analysis (36,000 genes evaluated), we investigated the molecular profile of these 80 clinical T cell products to: (1) elucidate differential gene expressions in the T-R12 and T-R6 cells; and (2) identify a predictive signature for GVHD. In the micro-array principal component analysis, the T-R12 and T-R6 cell products were clearly segregated with minimal product overlap; importantly, only approximately 6% of the total number of genes evaluated accounted for the unique T cell expression patterns. Using gene set expression analysis software, we found that the most significant gene family altered was the hypoxia-inducible factor family, which is associated with both inflammation and cancer. To address our second objective, we performed predictive modeling using BRB-arraytools software that enabled a leave-one-out analysis. This approach identified a 40-gene signature that correlated with GVHD potential with a high positive predictive value but a low negative predictive value. Therefore, this research has established that the T-R12 and T-R6 cell products, which differentially mediate GVHD, have differential gene expression profiles. Further studies will be required to determine whether a molecular signature can be used to predict GVHD potential.

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

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KAMALI JONES

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

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Understanding nuclear physics had led to numerous discoveries, most notably the MRI, and has applications across various disciplines. By studying the transitions between states of an excited nucleus, one is able to discover a vast amount of information about the nucleus. This summer, I focused my attention on ^{67}Ga. By examining the decay properties of ^{67}Ga, we were able to obtain information about the structure of the nucleus.

TRANSITION STRENGTHS IN 67GA

Excited states in ^{67}Ga were populated at Florida State University using an ^{18}O beam at 50 MeV impinging on a ^{55}Mn target. Prompt g-g coincidences were measured with a Compton-suppressed Ge array consisting of three Clover detectors and seven single-crystal detectors. The existing level scheme was verified based on the measured g-g coincidences. Lifetimes of 17 excited states were measured using the Doppler-shift attenuation method. Reduced electric quadrupole transition rates *B(E2)* were calculated from the lifetimes and compared with the predictions of the Interacting Boson-Fermion Plus Broken Pair Model (IBFBPM) from previous work. The evolution of shape with angular momentum was inferred from cranked Woods-Saxon calculations.

IRIS BENNETT,
DEPARTMENT OF MATHEMATICS, GRINNELL COLLEGE

Faculty Mentor: R.S. Linder
Department of Mathematics and Computer Science

Our research focused on improving inference on the correlation between two variables under Type II censoring, where data for only a portion of the original sample is available. Using simulation, we have found models that can be used to describe the sampling distribution of sample correlation coefficient under a commonly used transformation. This model allows for improved inference on the population correlation coefficient in the analysis of real-world experiments involving Type II censoring.

INFERENCE FOR THE CORRELATION COEFFICIENT IN A BIVARIATE NORMAL MODEL UNDER TYPE II CENSORING

Suppose that a sample of n bivariate Normal random variates (X, Y) is subjected to Type II censoring on one of its variates so that only p observations are made — specifically those associated with the p smallest values of X (single censoring) or the middle p value of X (symmetric censoring). Under Type II censoring p is predetermined. This scenario arises in particular industrial, life testing, and quality control applications.

The sampling distribution of the sample correlation coefficient, r, is mathematically intractable, with or without censoring. An arcsine transformation, known as Fisher's Z, is commonly used for full samples because it converges very rapidly to a Normal distribution. Fisher's Z is commonly used to make inference on ρ, the population correlation. In this work, we examine the performance of Fisher's Z transformation in making inferences about ρ in the presence of Type II censoring. We demonstrate that use of this transformation leads to very systematic errors in estimating the percentiles of the sampling distribution, leading to confidence intervals that have coverage probability far from nominal. We propose simple modifications to Fisher's Z transformation that are based only on experimental conditions (n and p). We then demonstrate that these modifications lead to greatly improved estimates of sampling distribution percentiles, and therefore to confidence level coverage rates far closer to nominal.

DOMINIQUE BERRY,
FLORIDA A&M UNIVERSITY, DEPARTMENT OF PHYSICS

Faculty Mentor: Dr. Harmon
Department of Physics and Astronomy

DETERMINATION OF STARSPOT LATITUDES ON LO PEGASI USING MULTIPLE PHOTOMETRIC FILTERS

LO Pegasi is a variable star known to have a period of about 10.15 hours. The relatively large variations in LO Pegasi's brightness indicate large starspots that are stable for many revolutions. Using a computational technique developed by Robert Harmon called Light-curve Inversion, the light curves can be used to model the surface of LO Pegasi. Unfortunately, any particular light curve can be yielded by a large number of possible surface spot patterns. As a result, multiple photometric filters are used to provide more information, because the light curves of different filters are affected differently by limb darkening. Analyzing the light curves and using what is known about the wavelength dependence of limb darkening allows for a spot's latitude to be found with greater precision.

DANIEL BLADOW,
DEPARTMENT OF COMPUTER SCIENCE, SCHOOL OF ENGINEERING, GONZAGA UNIVERSITY

Faculty Mentor: Sean McCulloch
Department of Computer Science and Mathematics, Ohio Wesleyan University

Some of the fastest computers play chess by looking at least 20 moves ahead and looking at every possible option, which is computationally time consuming. We are exploring strategies for computers to play board games in a way that does not require this kind of a search. Specifically, we are developing a probabilistic approach to a game called Battle Line to analyze the most likely future outcomes. By creating artificial intelligence that avoids computationally time consuming tasks and is based on mathematical principles, it is possible to use weaker computers, such as cell phones, that are capable of devising mathematical strategies to play games.

ARTIFICIAL INTELLIGENCE OF MODERN BOARD GAMES: BATTLE LINE

Many turn based board games played by computers use game state trees to determine what moves to make. Traversing through game state trees can be extremely time consuming, especially if the game involves random factors such as a deck of cards. Battle Line is a game where two players are competing over nine different three card poker hands using a 60 card deck with six suits and number values one through ten. Each hand is called a *flag* and the type of hand (such as straight flush or a three of a kind) is called a *formation*. Together, the deck and flags create an intractably large number of game states. We created an artificial intelligence where the computer uses a probabilistic approach to approximate future game states. We estimate future game states by determining the top formations we could make by playing a card from our hand on each flag. Then we calculate the odds of completing each formation, of each formation beating whatever the opponent can make, and finally of any of the top formations resulting in a win on that flag. By using probabilities the computer avoids traversing through numerous game states, and the computer's strategy is based on mathematical principles. There are two advantages to this approach to artificial intelligence. First of all, it is less time consuming and can be played on weaker computers, possibly cell phones. Secondly, the computer's thinking avoids ad-hoc strategic knowledge. It is given a mathematical concept and the rules of the game and then makes its own decisions about quality moves. Therefore, the computer is both more time efficient and capable of devising unique strategies based on mathematical principles.

JOY KIMMEL,
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE, GORDON COLLEGE AND

KRISTEN LEE,
DEPARTMENT OF MATHEMATICS, WEBER STATE UNIVERSITY

Faculty Mentor: Craig Jackson
Department of Mathematics and Computer Science

The earth periodically transitions between colder (ice ages) and warmer climate states. However, the interactions of the many mechanisms involved in the melting and growth of global ice are not fully understood. We develop a mathematical model that helps describe the transitions between these states with a system of differential equations. Our model gives insight on how ocean, bedrock, and climate dynamics contribute to these changes.

CONCEPTUAL PALEOCLIMATE MODELING

Since the mid-Pleistocene, the oscillations between glacial and inter-glacial climate states occur with a period of approximately 100 kyr. Each cycle is comprised of a slow glaciation with a subsequent rapid deglaciation. The solar forcing is clearly an important driver for these transitions. However, the power spectrum of the solar forcing is quite different from the subsequent climate response and, in general, does not have a noticeable correlation with global ice volume. Instead, previous studies show that internal climate processes and their interactions play a significant role in producing these global climate cycles. Some authors investigated the interaction of atmospheric feedbacks (e.g., CO2, water vapor) with dynamic bed processes and found that isostatic depression acts as an amplifier for these feedbacks (e.g., Birchfield 1985, Oerlemans 1980, Saltzman 1992). In addition, Pollard (1982, 1983) shows that calving may also play an important role specifically in contributing to the power spectrum of the climate response in the 100 kyr range.

Our study models the potential for ice/bedrock feedback to be a major contributor in shaping the glacial/inter-glacial climate oscillation, particularly the rapid deglaciation that immediately precedes an inter-glacial period. The ice sheet model we develop is adapted from a model by Oerlemans to include an ice/bedrock feedback while atmospheric and surface processes are taken to be as simple as possible. Due to the long timescale of the bedrock response and the rapid destabilization from calving, our model exhibits the slow glaciation and rapid deglaciation dynamics that are observed in the paleoclimate record. We plan to investigate more complex topography by including a dynamic forebulge at the coastline coupled to the continental bedrock response. We anticipate this resulting in a more realistic time series without compromising the simplicity of our model.

BRANDON SCHURTER,
COMPUTER AND INFORMATION SCIENCE DEPT., BEREA COLLEGE

Faculty Mentor: Christian Fink,
Department of Physics and Astronomy,
Ohio Wesleyan University

Over two million people in the US suffer from epilepsy, but the causes of these seizures are still poorly understood. One hypothesis suggests that highly connected neurons, called hub cells, play a role in the generation of epileptic seizures. Since this disorder is characterized by elevated synchrony in the brain, we ran simulations of networks of neurons to see what types of neurons, when placed as hubs, were best able to hijack the network to synchrony.

SYNCHRONIZATION PROPERTIES OF HETEROGENEOUS NEURONAL NETWORKS

Highly connected neurons, called hub cells, are thought to contribute to certain forms of epilepsy and have also been shown to orchestrate synchrony in the hippocampus of developing rats. How hub cells are capable of hijacking networks to synchrony is not well understood. We hypothesize that the excitability type of hub cells may be an important factor. In general, neuronal excitability (which characterizes how neurons respond to input) falls into two categories, Type I and Type II, with networks of only Type II neurons synchronizing very well, and networks of only Type I neurons synchronizing rather poorly. We used computer simulations to investigate the synchronization properties of networks with a mixture of Type I and Type II neurons. We were particularly interested in the effect of placing Type II neurons as hub cells in the network. The results of these simulations show that relatively few Type II neurons are capable of hijacking the network to synchrony when they are placed as hub cells, but not otherwise, indicating that Type II cells could play a role in generating epileptic seizures.

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

Student Name	Supervising Professor	Title
Mohammed Al-Issa	Jennifer Yates	The Anxiogenic Effects of Peptide YY3-36
Sarah Bechtel	Nancy Knop	A Qualitative Investigation on the Use of the functional Movement Screen to Promote a health Behavior Change
Rowland Brown	Sean McCulloch	Limiting the Branching Factor in State-Space Search
Hayley Cook	Ted Cohen	Multiracial Families in Modern Society: A Multifaceted Approach to Understanding Racially Blended Families in the Contemporary United States
Lauren Drake	Ted Cohen	Regulation and Refuge: Female Friendship in America Today
Marissa Esber	Vicki DiLillo	Perception of Opposite Sex Individuals as a Function of Hooking Up Frequency and Alcohol Consumption
Nora Gumanow	Sarah Bunnell	Effect of mood on Autobiographical Memory in Preschool Children
Gregory Hock	Nancy Knop	The Functional Movement Screen (FMS) and Predicting Performance Pain Among a Collegiate Overhand Throwing Population
Madeline Lank	Sally Livingston	The Functions of Fairy Tale Mothers in the Western European Literature
Ben Letson	Mark Schwartz	Population Stability of Self-Detrimental Altruism
Kate Lewis-Lakin	Joan McLean	Public Policy on Abortion in the States, 2011-2012
Addison Miller	John Krygier	The Spatialization of Identity in Dubai, UAE
Thomas Owings	Nancy Comorau	Reading the Map: One Country, Many Nations
Thomas Owings	Susan Gunasti	America's Civil Religions
Adrian Pekarcik	Laurie Anderson	Land Cover impact on Formicidae and Arthropod Community Structure at Small Spatial Scales
Megan Pinto	David Caplan	Rough Tounged Desire – A Poetry Manuscript
Luke Schwan	Michael Flamm	Missile Defense and US-Soviet Détente: Richard Nixon and Henry Kissinger's Pursuit of Peace, 1969-1972
Michelle Storms	Brad Trees	Entanglement Entropy in the Hubbard Model
Kelly Strick	Richard Leavy	Ready for Romance: Examining Relationship Self-Efficacy and Marital Attitudes in Emerging Adults in Light of Parental Divorce and Conflict
Rachel Vinciguerra	Michael Flamm	The "Devil's Bargain" and American Tourism: Selecting, Changing, and Distorting History
Dre White	Nancy Knop	Efficacy of a Program Based Upon Postural and FMS Assessments

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

2012 SSRP PARTICIPANTS

MARY ANN (JUNG HYUN) LEE, ’14

Recipient of a National Science Foundation Graduate Research Fellowship. Attending Arizona State University as a Ph.D student in Animal Behavior.

JENNIFER WALLACE, ’14

Attending the University of Minnesota Veterinary School. Spent summer 2014 volunteering at the Ohio Wildlife Center.

RACHEL THOMAS, ’14

Attending The Ohio State University’s College of Public Health to earn a Masters of Public Health with a concentration in epidemiology.

BETH HERDER, ’14

Lab technician at Food Safety Net Services

CHELSEA DENNIS, ’13

Molecular Biologist at Astrix Technology Group

2013 SSRP PARTICIPANTS

NATHAN MADONICH, ’16

Summer research intern at The Boyce-Thompson Institute at Cornell University in their plant genome internship

SHANE GORBETT, ’15

Working at the Columbus Zoo and Aquarium in the Animal Encounters Village Department where I will be responsible for animal shows, education, and Stingray Bay and continuing research with Dr. Hankison at OWU observing the effect of the presence of an infant on the dominance hierarchy of female mandrills.

THIN NU YEE, ’15

Received a TiPiT grant to expand research from SSRP project by collecting data from older adults in Myanmar. Collaborating with Dr. Lynda Hall at OWU who, with SSRP students, is collecting analogous data in America.

NIVE MANIVANNAN, ’15

Worked with Dr. Herbert DuPont at University of Texas School of Public Health, Houston, TX, Department of Infectious Diseases

JESSICA DEMES, ’16

Traveled to Italy for two weeks as part of the chemistry and art travel learning course, then shadowed doctors to prepare for applying to medical school.

HAYLEY WINSLOW ’15

Taking courses in Organic Chemistry and applying to Genetic Counseling graduate programs.

LAURA ROBISON, ’15

Traveled to Australia with a TiPiT grant entitled “Investigating Environmental Conservation through Ecological Research and Cultural Exploration Australia” to explore the management strategies used in Australia as well as volunteering with an organization to do wildlife restoration.

CRISSANDRA DIGGES, ’15

Participated in Ohio University College of Osteopathic Medicine’s Summer Scholars Program.

CAMPUS AND OFF-CAMPUS RESEARCHERS

NSF-REU/RET RESEARCHERS

SPECIAL THANKS

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

Summer Science
Research Program

Ohio Wesleyan University

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