September 21, 2015

Ohio Wesleyan University

Patricia Belt Conrades

Summer Science Research Symposium

CHLOE HAMRICK WILLIAMS

OWU '11, Fourth-Year Medical Student at Michigan State University College of Human Medicine

"My participation in research at OWU was one of my most meaningful college experiences. My hands-on, direct involvement in planning and organizing my own research projects under the guidance of my mentor helped me to get a research job for a private company immediately after graduating. Now, in medical school, my research experience stays with me as I apply the critical analysis hypothesis-based approach to caring for patients."

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-third 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 21, 2015 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 spend 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 though 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.

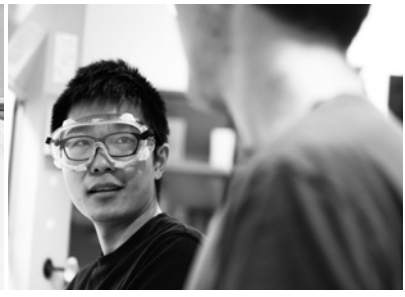
Just as importantly, the students share their findings orally at today's symposium. As you talk with them about their work, I encourage you to appreciate the depth of their understanding. They can explain their work because they understand the fundamentals of the project and have been involved in all 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



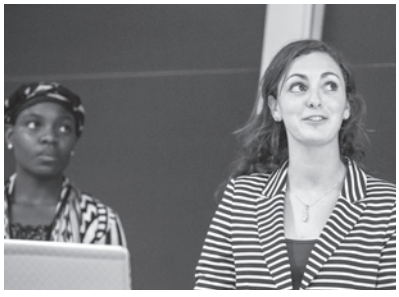
The Importance of Summer Research on a Career

When I first came to Ohio Wesleyan as a 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 lead 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

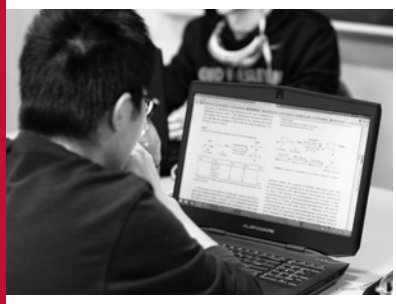
In Ohio Wesleyan's Summer Science Research Program (SSRP), students learn quickly that authentic research is quite different from classroom labs — more challenging, more creative, more frustrating, and, ultimately, more rewarding.

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 29 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 12 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 2015 Summer Science Research Program

Harry Phillip Bahrick Summer Research Fund
Joseph H. '30 and Elizabeth Brant Collaborative Research Fund
Jack E. '52 and Joyce A. Cornett Summer Science Research Fund
Herbert L. '61 and Margaret Wright '61 DuPont Collaborative Summer Research Fund
Ferry Family Foundation
Robert V. and Alice C. Kail Summer Science Research Internship
Marcia Kunstel '69
Albert A. Mills Jr. Summer Science Research Program Fund
National Science Foundation
David H. Smith '53 Fund for the Sciences
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

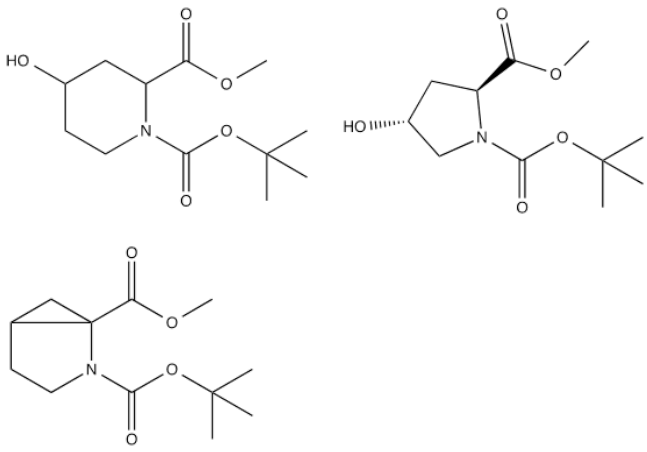
ALEXANDER LANDGRAF

Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

Cyclopropanation refers to the formation of three carbon cyclopropane rings. This is an important process in medicinal chemistry as many useful compounds bear this structure. For example some antibiotics contain these small rings. However the small size of these rings makes them challenging to produce. We have been looking into new novel ways to make these rings. We hope that we can shed new light on the formation of these rings and help develop more effective ways to generate and use them.

SYNTHESIS OF CYCLOPROPANATED ANALOGS TO PROLINE

Cyclopropanation was attempted on two similar ring systems that are analogous to the amino acid proline. The approach involved an intramolecular Sn2 reaction using an ester enolate nucleophile and a tosylate leaving group with potassium tert-butoxide as a base. The six membered ring system of N-Boc-4-hydroxypiperidine-2-carboxylic acid methyl ester (I) treated with tert-butoxide did proceed to form the cyclopropanated ring system 2-tert-Butyl -1-methyl-2-azabicyclo[3.1.0] hexane-1,2-dicarboxylate (III). The five membered ring system of N-Boc-trans-4-hydroxy-L-proline methyl ester (II) was found to be too strained for the cyclopropanation to occur. In that system elimination to N-Boc-3, 4-dehydro-L-proline methyl ester was found to be the major product. Various other bases were also tested but elimination still predominated.



Board 2

LUKE STEFFEN

Faculty Mentor: Laurel Anderson
Department of Botany and Microbiology

The emerald ash borer (Agrilus Planipennis), an invasive insect from Asia, has killed millions of American Ash trees and all the ash trees in OWU's Bohannon and Kraus Preserves. We are trying to figure out how the rest of the plant community responds to mass ash tree death in the Bohannon Preserve. We created six 20X20 meter plots, three with dead ash trees("experimental") and three without ("control"). We predicted that plots with dead ash will have more more maple saplings, more understory plants, more sunlight, and more invasive plants than plots without dead ash.

THE EFFECT OF *FRAXINUS AMERICANA* DEATH ON THE UNDERSTORY OF A CENTRAL OHIO DECIDUOUS FOREST

The emerald ash borer (*Agrilus planipennis*) is an invasive insect from Asia that has killed millions of American Ash (*Fraxinus americana*) trees in North America. It has killed nearly all the adult ash trees in Ohio Wesleyan University's Bohannon Preserve. In this experiment, we explored the possible effects of mass ash death on the rest of the ecosystem. We created six 20X20 square meter plots, three with dead adult ash trees(experimental) and three without dead ash (control) and conducted understory vegetation surveys in three randomly chosen 1x1 meter square miniplots within each 20X20 meter plot. We predicted that experimental plots would have more maple saplings, more invasive plants, and a greater number of understory plants than those in the control plots. We also predicted that plots with dead ash would have more available sunlight. No invasive plants were found in the understory or mid level of the forest, and no significant difference was found in the forest cover, available sunlight, number of maple seedlings, or total number of small stems in the control and experimental plots. This data suggests that the forest is more resilient to the death of ash than we predicted and that mature tree canopies expanded quickly in response to the death of ash. A full analysis of understory species composition is still in progress.

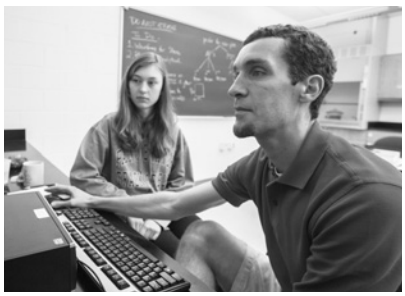
Board 3

MARK CHALMERS, OHIO WESLEYAN UNIVERSITY
ROBEL GEDA, RUTGERS UNIVERSITY
BRANDI HENRY, EASTERN UNIVERSITY
VIESULAS SLIUPAS, OHIO WESLEYAN UNIVERSITY

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

STARSPOTS ON LO PEGASI, 2006-2015

Starspots are regions of strong magnetic field that exist in several classes of stars, including our own Sun. These spots are darker than the surrounding surface, and as the star rotates they are carried into and out of view, changing the observed brightness of the star. Light curves of LO Pegasi obtained at Perkins Observatory through standard B, V, R and I photometric filters from 2006-2015 were used to study the evolution of spots on its surface over time. A computational technique known as Light-curve Inversion (LI), developed by R. Harmon, was used to produce surface maps of the star from its brightness variations. LI divides the surface of the star into rectangles of equal area and determines 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. Choosing the smoothest surface avoids having the solution be dominated by noise artifacts. Based on Doppler images of LO Pegasi created elsewhere, we know that LO Pegasi has a spot roughly centered on one pole. Year-to-year changes in the star's average brightness imply changes in the size of the polar spot. We present maps of the surface that account for both the rotational and year-to-year brightness variations.



Board 4

ERIC BAUGHMAN

Faculty Mentor: Suren Ambegaokar
Department of Botany and Microbiology

Alzheimer disease is a crippling disorder that slowly kills brain cells, most commonly in older adults, and few effective treatments exist due to limited understanding of the disease. One known characteristic of disease pathology is the build-up of a protein, tau, throughout the brain. We are studying how a gene, *microRNA-7*, regulates the severity of tau-associated neuronal death. Understanding this genetic interaction will lead to better understanding of Alzheimer pathology, and may lead to better treatments for the disease.

DETERMINATION OF DIRECT INTERACTION BETWEEN MICRORNA-7 AND INSULIN RECEPTOR SUBSTRATE (IRS) MRNA IN *DROSOPHILA*

Alzheimer disease is a neurodegenerative disease with several hallmarks, including the formation of intracellular aggregates of the protein, tau. It has been previously shown using *Drosophila melanogaster* as a genetic model that microRNA-7 (*miR-7*) modulates the toxicity of tau-associated neurodegeneration through the insulin receptor pathway. We hypothesized this is due to *miR-7* binding to and inhibiting translation of the mRNA encoding Insulin Receptor Substrate (IRS), which affects the activation state of the kinase GSK-3β. GSK-3β activity is associated with increased tau-induced neurotoxicity, through both direct and indirect interactions with tau. We sought to determine if there is a direct interaction between *miR-7* and the gene chico, which is the *Drosophila* homolog to human IRS. To allow for monitoring of *chico* gene expression in the presence of *miR-7*, the coding region (CDS) and 3' untranslated region (3' UTR) of the *chico* gene were fused with DsRed gene to be co-transfected with a plasmid that co-expressed *miR-7* and green fluorescent protein (GFP). Both plasmids were transfected into human cell lines (HEK cells) and monitored by fluorescence microscopy. It was predicted that co-transfected cells would have a decrease in red fluorescence and an increase in green fluorescence due to *miR-7* binding to *chico*-DsRed mRNA, thereby inhibiting its translation. Determining this interaction will provide a better understanding of tau-induced neurodegeneration and potential mechanisms to mitigate Alzheimer disease pathology.

Board 5

EUGENE LIM

Faculty Mentor: Christian Fink
Department of Physics and Astronomy

Only 2/3 of patients diagnosed with epilepsy respond to some form of medication, and many may even require treatments involving invasive brain surgery. To pinpoint the exact brain tissue to operate on, high frequency brainwave activities have been postulated to mark the affected area. To improve the determination of epileptic tissue in the brain, further study of the way in which these high frequency brainwave activities are generated is paramount. We are developing a new mathematical model which describes how independent, asynchronous firing of neurons could generate emergent high-frequency oscillations in the brain.

MODELING HIGH FREQUENCY OSCILLATIONS TO DETERMINE EPILEPTIC MECHANISMS

High-frequency oscillations (HFOs) have been postulated to be potential biomarkers for focal epileptic seizures, with fast ripples (>250 Hz) being the most interesting candidate. The mechanisms underlying the generation of fast ripples, however, are still not well understood. In this study, we draw upon results from previous computational studies on HFOs to develop a new mathematical model from first principles, describing the generation of emergent HFOs through asynchronous neuronal firing. Asynchrony in the model is obtained with the introduction of two parameters of heterogeneity: the variability in the inter-spike interval (ISI) and jitter. Furthermore, initial spike times are uniformly distributed over a predefined duration of the ISI to account for random initial phases. The model predicts the generation of harmonic narrow-band oscillations across the fundamental given the heterogeneity-governing parameters do not differ from the predefined ISI by 20%. Comparisons against results from a separately constructed computational model are then made to verify the accuracy of the model in study. These results provide us with a rigorous framework in which we may investigate the mechanisms driving the generation of abnormal HFOs, and may serve as groundwork for future research in epileptogenesis

Board 6

MEGHAN SCHULZE, EMILY SCOTT, AND NAA-OYE BOSOMPRA

Faculty Mentor: Jennifer Yates
Department of Neuroscience

More than a quarter of a million Americans are currently living with a spinal cord injury, most often due to automobile accidents, falls, or gunshot wounds. After the initial injury, the condition is made worse by the body's own effort to protect itself. The human immune system is activated and produces neurotoxic molecules and causes oxidative damage, which can cause a decline in motor and sensory function. We need to study animals similar to humans that produce these neurotoxins, such as gerbils and guinea pigs, because rats and cats do not. We originally proposed using a guinea pig model to investigate whether drug therapies could reduce the harmful immune related mechanisms, but our research has been delayed. Instead, we devoted part of our summer to expanding our knowledge and informing the public about the importance of animal research, emphasizing the significance of communication to the advancement of animal research and therefore scientific progress.

SPINAL CORD INJURY RESEARCH AND ANIMAL ACTIVISM

More than a quarter of a million Americans are currently living with permanent long term deficits after a spinal cord injury, such as paralysis or loss of sensation. The human immune system is activated after an initial injury causing oxidative damage and producing a neurotoxin called quinolinic acid (QUIN) which can cause a decline in motor and sensory function. We proposed to study how to therapeutically reduce secondary injury in guinea pigs because other animal's macrophages, such as rats and cats, do not produce QUIN like those in humans do. Guinea pigs are covered by the Animal Welfare Act, which is enforced by the U.S. Department of Agriculture (USDA). Ohio Wesleyan's most recent inspection with the USDA resulted in four citations for paperwork errors. Because of these citations, a national animal rights group brought media attention to our research and we voluntarily delayed our research to address potential security concerns for animals and student researchers. We devoted part of our summer to expanding our knowledge and informing the public about the importance of animal research, emphasizing the importance of communication to the advancement of animal research and therefore scientific progress.

Board 7

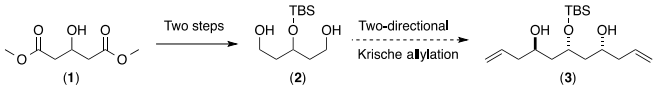
JUSTIN OVERHULSE

Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

The organic synthesis of natural products such as cryptocaryol A is very important for medicinal chemistry. The existing synthesis of cryptocaryol A is lengthy and requires extreme temperatures (-78°C). I am working to provide a new process that will enable an efficient synthesis under easier conditions.

STUDIES DIRECTED TOWARDS THE SYNTHESIS OF CRYPTOCARYOL A

Cryptocaryol A is a natural product with potential anticancer properties. This project explored the use of a novel allylation methodology developed by Michael Krische and coworkers. This approach required the synthesis of 3-((*tert*-butyldimethylsilyl)oxy)pentane-1,5 -diol (**2**), which was the key substrate for a two-directional allylation reaction. Diol **2** was prepared in two steps from commercially available dimethyl 3-hydroxypentanedioate (**1**). The alcohol was first protected as a TBS ether, affording 3-((*tert*-butyldimethylsilyl)oxy)pentanedioate in 96% yield. The diester was reduced subsequently reduced to provide diol **2** in 85% yield. Unfortunately, the Krische allylation of diol **2** proved difficult under a variety of experimental conditions, affording at best only very poor yields of (4R,8R)-6-((*tert*-butyldimethylsilyl)oxy)undeca-1,10-diene-4,8-diol (**3**). Alternative approaches to the synthesis of compound **3** are currently under exploration.



Board 8

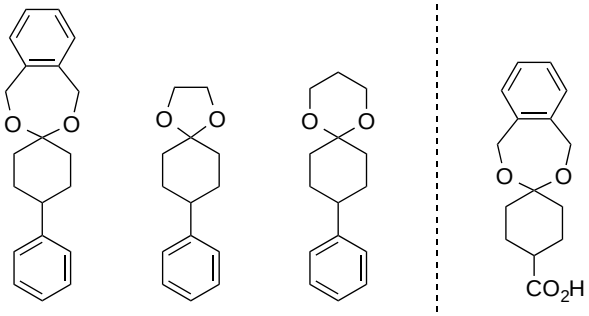
REBECCA MANNING

Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

Oxidation is a fundamental chemical reaction involved in the combustion of fossil fuels, metabolism, and atmospheric chemistry. Ozone is a powerful oxidation agent, commonly used in an oxidation reaction called ozonolysis. This research explored novel uses of ozone in organic chemistry.

NOVEL OXIDATIVE CHEMISTRY INITIATED BY OZONE

Ketals are commonly employed protecting groups in organic chemistry. Ozone, a powerful oxidant, has not been broadly employed in ketal deprotection, but preliminary evidence suggests that oxidative deprotection of ketals using ozone might be feasible. However, further research needs to be done. Three ketals (**1**-**3**) were synthesized to test this deprotection method. The products were purified via recrystallization and column chromatography. Thin layer chromatography and both 1H NMR and 13C NMR spectroscopy were used for characterization. The ozonation of ketal **1** was investigated at -78˚C, both with dry ozonation on silica and in solution. Ozone was produced for these reactions by an ozone generator. Unexpectedly, oxidation of the phenyl ring occurred producing a carboxylic acid (**4**). Additional studies directed at better understanding this reaction and potential synthetic applications are ongoing.



1 **2** **3** **4**

Board 9

DAISY VON GLAESER

Faculty Mentors: Ramon Carreno and
Laura Tuhela-Reuning
Department of Botany and Microbiology

I studied three different parasites found within a millipede's hindgut. First I captured and dissected the millipedes and then prepared them to be viewed under the Scanning Electron Microscope. When the parasites were viewed under the Scanning Electron Microscope I determined key identification features on the parasites' heads and tails. These key features were used to help identify the species of parasites.

CHARACTERIZATION OF A DIVERSE NEMATODE PARASITE COMMUNITY FROM MILLIPEDES USING SCANNING ELECTRON MICROSCOPY

In eastern North America, the millipede, *Narceus americanus*, has been shown to be infected with several species of gut-inhabiting parasitic nematodes. The objective of this research was to study and to characterize this diverse parasitic community in millipedes. The three nematodes studied are from the genus *Aorurus*, *Thelastoma*, and *Rhigonema*. *Narceus americanus* were captured from southeastern Ohio and their hindguts' dissected. Parasites were preserved in 5% formalin for at least 72 hours before being dehydrated in ethanol and then critical point dried by the Autosamdri 795 Supercritical Point Dryer and gold coated. Once properly prepared the nematodes were view under the Zeiss EVO LS10 scanning electron microscope (SEM). Important and relevant structural characters were studied to help identify the species of the three different nematodes found in the gut. The nematodes were found in the hindgut in a specific order consist with all millipedes dissected. From the back of the hindgut forward the *Aorurus* was found first, then the *Thelastoma*, with the *Rhigonema* found after in a large bundle where the hindgut constricts. *Thelastoma* and *Aorurus* have long elongated tails and *Rhigonema* has a conical tail. Other key characteristics such as buccal cavity, amphids, cuticle, and other surface features were used to determine the species of all three nematodes

Board 10

CHIN LUNG TAN

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

The contribution of nuclear physics to the world is reflected in technologies such as the MRI and the nuclear power plant, whose working principles rest on our understanding of the nucleus. In nuclear physics, single-particle models and collective models are used to explain the behavior of a nucleus, which is yet to be fully understood. Incidentally, Ga70 is one of those nuclei that exhibit behaviors that require both kinds of models for explanation. Therefore, studying Ga70 essentially allows us to test these models and gain more insight into what really happens inside a nucleus.

EVIDENCE FOR DEFORMATION IN ^{70}GA

The high-spin decay of the odd-odd ^{70}Ga nucleus was studied using a fusion reaction at Florida State University in which a ^{14}C projectile beam, accelerated to an energy of 50 MeV, impinged on a ^{62}Ni target. Gamma rays that depopulated the ^{70}Ga excited states were recorded in coincidence with a high-resolution Ge array consisting of three clover detectors and seven single-crystal detectors. The existing ^{70}Ga level scheme was modified, enhanced, and extended to higher spin based on the analysis of double- and triple-coincidence γ-ray spectra. Five of these transitions are associated with a new rotational band that may be based on the occupation of the $g_{9/2}$ orbital by the unpaired proton and neutron, driving the nucleus to a deformed shape. The normalized energy differences between adjacent spin states in this new band indicate a "signature-splitting" pattern that is characteristic of other such bands in neighboring odd-odd nuclei. Similarly, the kinematic moments of inertia deduced for this decay sequence evolve with angular frequency in a manner typical of analogous bands in other odd-odd nuclei in this mass region.

Board 11

CYNTHIA HASTINGS

Faculty Mentor: Laurel Anderson
Department of Botany and Microbiology

Alliaria petiolata (garlic mustard) is a European invasive plant to the USA. The factors of garlic mustard success are not well understood, but the ability to predict garlic mustard success could help prevent further invasion. Knowing garlic mustard is sensitive to soil phosphorus availability, we looked for relationships between phosphorus and garlic mustard success. We also suspected decaying wood or previous garlic mustard habitation could cultivate greater densities or weights of garlic mustard.

GARLIC MUSTARD RESPONSES TO SOIL PHOSPHORUS AVAILABILITY

The European plant species *Alliaria petiolata* (garlic mustard) is invasive in 34 states in the USA. In some areas garlic mustard is abundant, where other areas contain little or no garlic mustard. The factors for successful garlic mustard invasion are not well understood, so this study looked for a relationship between garlic mustard success with or without decaying wood and with or without previous garlic mustard habitation in the Ohio Wesleyan University's Kraus nature preserve. We suspected decaying wood releases phosphorus into the soil, and previous greenhouse studies showed that garlic mustard is sensitive to soil phosphorus availability. We also suspected the decay of phosphorus-rich garlic mustard leaves will enhance available soil phosphorus, so sites previously inhabited by garlic mustard will either increase the weight or count of current garlic mustard plants in those sites. In our study, garlic mustard seeds were planted in specific areas with or without decaying wood and with or without previous garlic mustard habitation. A year later, we recorded the number of rosettes at each site, harvested and weighed the plants, and analyzed the data for significant trends. In another study we recorded the number of rosettes and mature garlic mustard plants in 2x2 meter plots. This data has been collected for multiple years, so we looked for long-term trends in the garlic mustard densities. We then took soil samples of these sites to look for a correlation between nutrients, such as phosphorus, and garlic mustard densities. Our data with previous garlic mustard habitation showed a borderline significant increase ($p=0.052$) in biomass of garlic mustard plants, but our data did not support our other predictions of increased garlic mustard densities or weight in the presence of decaying wood. Our soil analyses are currently underway. Future work to predict garlic mustard tendencies can protect native flora and fauna from invasive disturbance and better scientist's understanding of invasive species impacts on an ecosystem.

Board 12

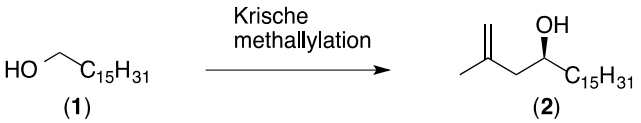
ZHIYAO LI

Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

Organic synthesis is important for the manufacture of medicines. This research was based on a natural product called cryptocaryol A, an organic compound with anticancer properties. The research involves two separate topics, both related to developing a more efficient synthesis of this interesting natural product.

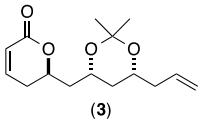
PROGRESS TOWARD THE TOTAL SYNTHESIS OF CRYPTOCARYOL A

This project involved the optimization of key steps in the synthesis of the natural product cryptocaryol A. The planned synthesis relies on the joining of two precursors ("left and right hand domains"). The existing synthesis of the right hand domain relied on a Leighton allylation for the installation of the stereocenter at C16. This project investigated a new approach using an enantioselective methallylation developed by the Krische group at the University of Texas. In the course of these studies, the desired product (S)-2-methylnonadec-1-en-4-ol (**2**) was obtained from 1-hexadecanol (**1**) in an optimized yield of 78%. Future studies will be required to measure the enantiomeric excess of the product.



(**1**) (**2**)

The planned synthesis of the left hand domain requires the selective oxidation of the terminal alkene in (*R*)-6-(((*4R,6R*)-6-allyl-2,2-dimethyl-1,3-dioxan-4-yl)methyl)-5,6-dihydro-*2H*-pyran-2-one (**3**). In order to test conditions for selective oxidation, a two-component model system consisting of 6-phenethyl-5, 6-dihydro-2H-pyran-2-one (**4**) and (3-methoxyhex-5-en-1-yl) benzene (**5**) was synthesized. 1-phenylhex-5-en-3-ol was prepared in 54% yield via Grignard allylation of 3-phenylpropanal. Subsequent methylation afforded compound **5** in 96% yield. 1-phenylhex-5-en-3-yl acrylate was prepared by esterification of 1-phenylhex-5-en-3-ol in 70% yield. Ring closing metathesis using the Grubbs first generation catalyst afforded the dihydropyranone **4** with an optimized yield of 87%. Ozonolysis in the presence of pyridine and Sudan Red proceeded selectively as desired, and these conditions were also applied successfully to compound **3**.



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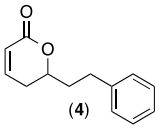

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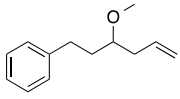

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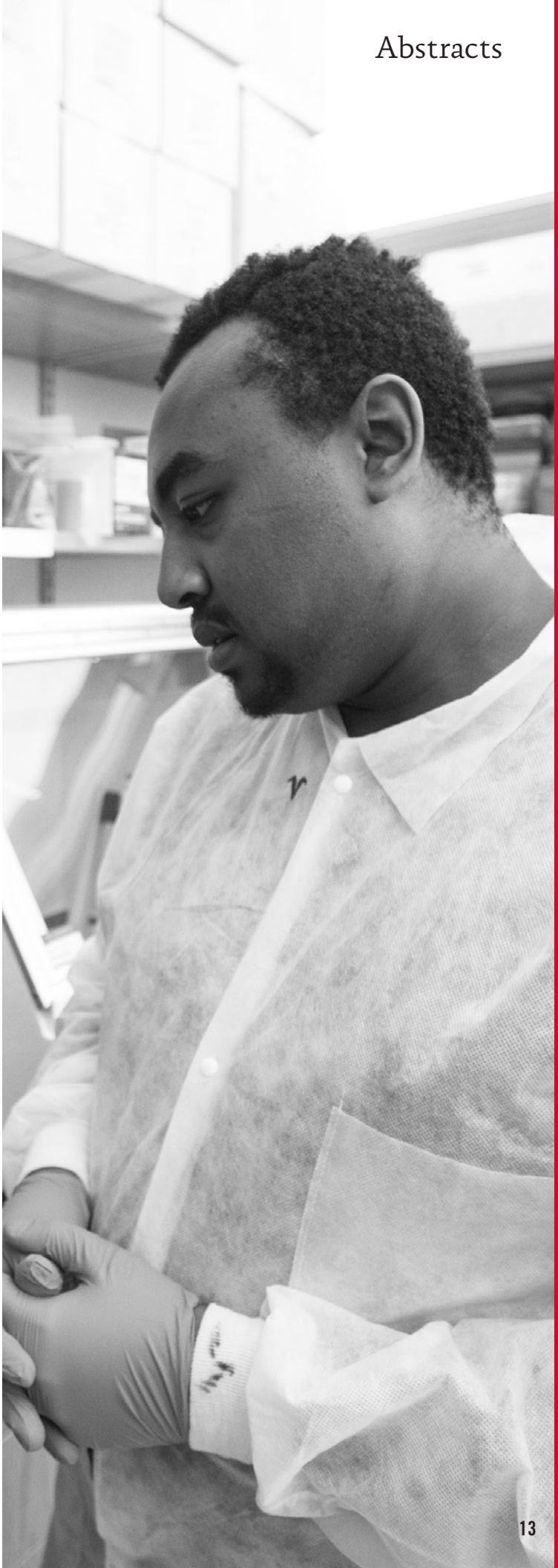
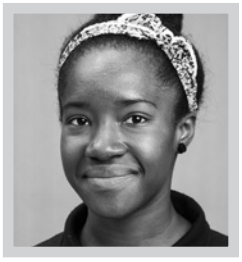


Board 13

DARA MARKUS, ONYINYE OKOLI DAVID TANGBAU AND SUSANNAH WAXMAN

Faculty Mentor: Chis Wolverton
Department of Botany and Microbiology



We're focusing on comparing how roots of two different types of a model plant, *Arabidopsis thaliana*, respond to differences in perceived gravity. One type of this plant senses gravity mostly with the help of tiny, stone-like bodies that sediment at the base of each specialized root cell, letting the plant know which way is down. Despite the lack of these stone-like bodies in the other type of plant, we know that this plant still has some idea of how it's oriented. By putting both types of these types of plants in an environment with nearly zero gravity, these stone-like bodies won't be able to fall "down" and we can begin to tease out the nature of this mystery orientation sensor.

MYSTERY PLANT GRAVITY SENSOR: PREPARATION FOR MICROGRAVITY EXPERIMENTS ON THE ISS

Amyloplasts are starch rich plastids found in root columella cells which aid in a plant's perception of gravity. When the orientation of a columella cell is altered from vertical, amyloplasts begin to sediment toward the new downward direction until reaching the base of each cell. An auxin gradient subsequently forms at the bottom of the root, hindering cells from expanding in that region. The cells at the top of the root expand more quickly than the cells at the bottom of the root, resulting in a downward curvature of the root tip and a reorientation to a vertical direction of growth. In the *pgm-1* mutant variety of *Arabidopsis thaliana* which is unable to synthesize starches, starchless amyloplasts don't sediment to the bottom of columella cells like they would in a normal plant. The rate at which *pgm-1* mutants are able to respond to reorientation is significantly slower than that of plants which are able to synthesize starch. However, perception of gravity in these mutants is not entirely lost. This suggests the existence of another system of plant gravity perception. By analyzing seedlings in microgravity conditions, we hope to elucidate the component of plants' gravity sensing system that's outside the influence of amyloplast sedimentation.

In preparation for sending experiments to the International Space Station (ISS), we have been optimizing and collecting data from ground controls for both *pgm-1* and WT plants. Environmental conditions that simulate those in Seed Cassettes designed for the EMCS have been constructed. The optimal age at which seedlings begin to be analyzed has been deduced to be 72 hours old. No correlation between the rate of seedling growth and the sucrose concentration of the media on which they are grown has been observed. Cl_2 gas seed sterilization has been performed. How long seeds will remain viable once prepared, and how these mutants will respond to the elevated CO_2 conditions on the ISS are topics that will be thoroughly explored before conducting gravity stimulation experiments in microgravity conditions.

Board 14

MADISON SNIDER

Faculty Mentor: Shala Hankison
Department of Zoology

Mating behaviors are an important part of sexual selection and evolution. These behaviors have been well studied in some fish, such as the U.S. sailfin molly, *Poecilia latipinnia*, where courtship behaviors can vary between males. However, the females of this species can store sperm from many different males, including males with traits that the females prefer and males without these traits. This has led to our study of looking for correlations between male mating behaviors and which males actually father a brood.

PATERNITY AND BEHAVIOR IN THE SAILFIN MOLLY, *POECILIA LATIPINNIA*

Female mating preferences can result in preferential mating with males with certain preferred characteristics. In the sailfin molly, *Poecilia latipinnia*, for example, females prefer larger males who perform elaborate courtship displays over smaller males who more often attempt to use coercive mating strategies. However less is known about how male behaviors and female preferences may interact in multiple paternity systems. To address how mating behaviors influence paternity, we investigated the use of eight microsatellite loci to identify multiple paternity in *P. latipinnia*. We first established that eight loci would amplify in our fish, and then confirmed variation among individuals in these loci that would allow us to match offspring to potential sires. This summer we laid the groundwork to look into the relationship between courtship displaying males and what males actually father the offspring. We hypothesized that larger males that perform more courtship displays would father more offspring compared to smaller or lower-courting males. Next, we will observe mating behaviors and determine whether there is a correlation between male mating displays and brood paternity.

Board 15

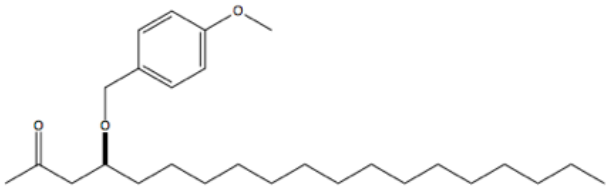
ERIN BOEDICKER

Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

The compound cryptocaryol A is a complex molecule that has been found to have interesting anti-cancer properties in vitro. The complex nature of the molecule causes its construction to involve many small steps, which proves to be quite inefficient. Achieving a productive pathway for preparing cryptocaryol A could be useful in understanding the construction of other complex biological compounds. The project this summer aimed to optimize the formation of the molecule by finding a shorter, more efficient synthesis.

SYNTHESIS OF CRYPTOCARYOL A: OPTIMIZATION OF THE RIGHT HAND DOMAIN

The natural product cryptocaryol A has been found to stabilize the production of the protein Programmed Cell Death 4 (PDCD4), which acts as an efficient tumor suppressor. The structure of the compound contains a long carbon chain with complex stereochemistry, and the published synthesis incorporates twenty-three steps. The development of a more efficient synthesis for the compound was explored. In optimizing the right hand domain of the molecule (**1**), two main issues were addressed: the attachment of the 4-methoxybenzyl ether (PMB) protecting group and the final oxidative step of the synthesis utilizing a Wacker oxidation, both of which gave inconsistent results. To pilot the conditions of the synthesis, a racemic mixture of the compound nonadec-1-en-4-ol was synthesized from hexadecanal using a Grignard reaction. Various synthesis conditions were then tested on the racemic mixture before being applied to the enantiomerically pure material (S)-nonadec-1-en-4-ol. The PMB group was attached using a Williamson-ether approach, which proved quite successful and resulted in a yield range of 44-75%. Several conditions for the Wacker oxidation were explored; the pathway involving only a palladium (II) catalyst was found to be most efficient and resulted in a yield range of 50-76%. These conditions were then applied to the enantiomerically pure material; the PMB protection resulted in a 68% yield and the Wacker oxidation with the palladium (II) catalyst resulted in a 50% yield. The final compound, (S)-4-((4-methoxybenzyl)oxy)nonadecan-2-one (**1**), was successfully synthesized in a yield of 0.128g; this sample will be used later to complete the synthesis of cryptocaryol A.



(**1**)

Board 16

KHANH LE

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

Braid groups, a mathematical structure, were first introduced by Emil Artin in 1925. Since then scientists have applied braid theory to study the structure of crystal or DNA. A recent paper gave a correspondence between these groups of braids and the groups of matrices with two parameters *q, t,* which are the subjects of our study. Even though the groups of matrices have no sub-structure, we conjectured that by replacing the parameter *t* with a root of 1, a sub-structure can be found. We prove this is indeed the case.

SPECIALIZATIONS OF THE LAWRENCE REPRESENTATIONS OF THE BRAID GROUPS AT ROOTS OF UNITY

The braid groups, B_n, were first defined by Emil Artin in 1925 and since then have come to play an important role in many areas of mathematics and physics including topology, geometric group theory, quantum algebras, and conformal field theories. One of the longest open questions related to braid groups was answered in 2000 by Bigelow and Krammer, who proved that the braid groups are linear by exhibiting a faithful representation of B_n on the homology module of a certain configuration space over the ring $Z[q,t]$. This representation, known as the Lawrence-Krammer-Bigelow (LKB) representation, is one of a family of homology representations, $H_{n,l}$, first discovered by Ruth Lawrence in 1990. In particular, $H_{n,2}$ is the LKB representation while $H_{n,1}$ is isomorphic to the famous Burau representation B_n.

In 2011, Jackson and Kerler proved that the Lawrence representations are irreducible over the quotient field $Q(q, t)$. Moreover, they showed that when the parameters are specialized to $tq = -1$, the Lawrence representations admit a subrepresentation isomorphic to the Temperley-Lieb representation and that the natural short exact sequence corresponding to this subrepresentation does not split for $n \geq 4$.

In our study we investigate a different specialization of parameters. In particular, we show that when t is specialized at a primitive root of unity ($t^l = 1$) the Lawrence representations admit a subrepresentation isomorphic to the Burau representation B_n. Furthermore, we prove that the corresponding short exact sequence

$$0 \to \mathscr{B}_n \hookrightarrow H_{n,\ell}\big|_{t^\ell=1} \twoheadrightarrow H_{n,\ell}\big|_{t^\ell=1}/\mathscr{B}_n \to 0$$

does not split for $n \geq 4$. However, for $n = 3$ we show that the sequence splits under the condition $q = t$. Hence, this proves the existence of a complementary subrepresentation in this case. Of further interest is the relation between this subrepresentation and the subrepresentations previously shown to exist for the specialization $tq = -1$.

Board 17

JESSICA GOODEN AND BETH KUROWSKI

Faculty Mentor: Scott Kelly
Department of: Zoology

We are studying how exercise impacts cancer. Previous research has determined that most cancers (90-95%) are caused by lifestyle choices and our interaction with the environment. We are observing 40 mice; half of them will be given the opportunity to exercise (access to a running wheel). After 29 weeks, we will see if the active mice have any significant differences in cancer development than the non-active mice.

EFFECT OF VOLUNTARY EXERCISE ON AZOXYMETHANE-INDUCED INTESTINAL TUMOR INITIATION, NUMBER, AND SIZE

Colorectal cancer (CRC) is the third most common death-related cancer. Previous human and rodent studies have found consistent evidence that physical activity reduces the risk of colon cancer, but the extent of the protection varied with genetic background and the timing of the activity relative to the onset of CRC. Although hypotheses have been proposed, the mechanistic basis of the protective effects is currently unknown. The majority of previous studies examined end point phenotypes (e.g., tumor number) and did not investigate the initiation and progression of colorectal tumors. Here, we expand on these studies to examine the effects of exercise on the initiation and progression of CRC. We utilized female mice of the A/J strain to investigate the effects of voluntary wheel running on tumor initiation, growth rate, number and size. Mice ($n = 40$) were randomly assigned either to the control group, which was not allowed wheel access, or the experimental group, which had wheel access for 5 weeks. For individuals with access to voluntary running wheels, daily activity was monitored and the following running traits were calculated: total daily revolutions, time spent running, average speed, and maximum speed. A week after wheel access was granted, CRCs were induced with 5 weekly injections of azoxymethane (AOM), a colon-specific carcinogen. To quantify tumor initiation and progression, weekly colonoscopies were performed 12 weeks after the first injections. At the end the colons were dissected, and tumors were counted and measured. In addition to comparing the differences between the exercise and non-exercise groups, we will examine, at the level of individual, the affects of various measures of wheel running within the wheel running group. Given that exercise has been shown to decrease the risk of CRC, knowing more details about the relationship between exercise, tumor initiation and tumor progression can help provide people with better preventative recommendations.

We are studying how exercise impacts cancer. Previous research has determined that most cancers (90-95%) are caused by lifestyle choices and our interaction with the environment. We are observing 40 mice; half of them will be given the opportunity to exercise (access to a running wheel). After 29 weeks, we will see if the active mice have any significant differences in cancer development than the non-active mice.

Board 18

MADDIE VROOM

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

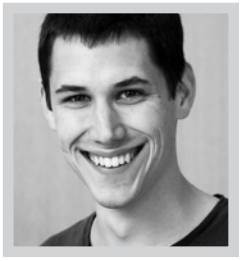
In a daily ritual referred to as "preening", songbirds spread a thick, viscous oil across their feathers that may provide protection against feather-destroying *Bacillus* bacteria. We determined if *Bacillus* bacteria were attracted towards various concentrations of proline, valine, and asparagine, which are chemicals found in bird feathers. These experiments established a base for us to then test the possibility that preen oil functions as a protective physical barrier against feather-destroying *Bacillus* bacteria. We found that increasing the thickness of the chemical solutions inhibited bacterial movement.

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

Bacillus spp. isolated from songbird plumage are motile, chemotactic bacteria that are known to utilize feathers as a source of nutrients by degrading the protein β-keratin. Given the importance of maintaining feather quality, the preen oil birds distribute across their plumage is thought to provide protection against feather-degrading bacteria, although it is unclear how it does so. To investigate the possibility that the viscosity of preen oil functions as a physical barrier against the chemotactic movement of Bacillus towards areas of feather damage, we characterized the motility and chemotaxis of *Bacillus* spp. isolated from songbird plumage towards three amino acids present in the degradation of β-keratin. *Bacillus* spp. were screened, and those with a high percentage of motility were selected for further study. Growth curves and motility assays were performed for each isolate, and the highly-motile *Bacillus* isolate 4201TV was selected for further study. The chemotactic response of 4201TV was determined via chemotaxis assays using modified Palleroni chambers. Proline, valine, and asparagine at concentrations of 250 μM and 750 μM were used as chemoattractants. Viscosity assays were subsequently performed using 750 μM proline or asparagine and 0.05% agar to mimic the viscosity of preen oil to determine if there was a corresponding reduction in the chemotactic response of isolate 4201TV with increased viscosity. Average response ratios of 5.89, 7.93, and 39.45 indicate that *Bacillus* isolated from songbird plumage are chemotactic towards proline, valine, and asparagine at a 750 μM concentration, respectively. In addition, an increase in viscosity inhibits the chemotactic movement of feather-degrading bacilli as suggested by a decrease in response ratio for arginine from 47.93 to 1.13 in the presence of 0.05% agar.

Board 19

DOUG GIBSON

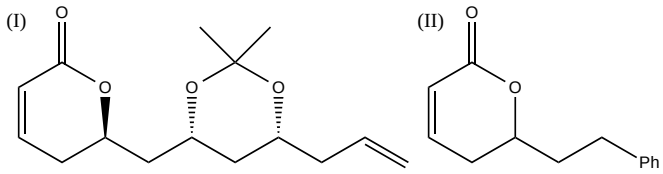


Faculty Mentor: Mark Mitton-Fry
Department of Chemistry

Cryptocaryol A is a natural product with potential anticancer applications. One of the steps in a newly designed synthesis for cryptocaryol A proceeds very poorly. In order to test new methods for improving the step, a model system was created to help demonstrate what other approaches may or may not work.

CRYPTOCARYOL A: SYNTHESIS OF A MODEL SYSTEM FOR SELECTIVE ALKENE OXIDATION

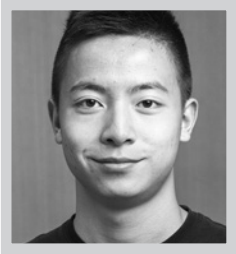
Cryptocaryol A is a natural product with potential anticancer applications. An improved synthesis, focusing on significantly reducing the number of steps, was devised in order to be able to produce cryptocaryol A more efficiently. One step in this synthesis requires selectively oxidizing the terminal alkene in structure (I) without oxidizing the dihydropyranone alkene. A previously investigated method involving dihydroxylation followed by lead (IV) acetate treatment proceeded only in poor yield. In order to test other approaches to this step a model system, 5,6-dihydro-6-(2-phenylethyl)-2H-pyran-2-one (II), was designed. Compound (II) was synthesized in three steps: hydrocinnamaldehyde and allyl magnesium bromide were reacted to afford 1-phenylhex-5-en-3-ol; esterification with crotonic acid produced 1-phenylhex-5-en-3-yl-(E)-but-2-enoate; and ring closing metathesis in the presence of Grubbs 1st generation catalyst was used to create substrate (II). The model will be used to test other oxidation methods: if the alkene does not react, it suggests that the dihydropyranone alkene in structure (I) will not react either. Additionally, the third step in the synthesis of (II) will also be used to optimize the ring closing metathesis step to produce substrate (I) in the synthesis of cryptocaryol A.



Board 20

YUXIAO TAN

Faculty Mentor: Suren Ambegaokar
Department of Botany and Microbiology



The immune system in the brain is regulated differently than other parts of the body in order to prevent unwanted damage to neurons – the major functional cell type of the brain. However, the brain is still vulnerable to infection, which may lead to acute inflammation and brain damage, or may cause subtler, long-term effects to the brain. We are studying how neurons respond to infections to better understand how the immune system is regulated in the brain, which will help in developing therapies for neuronal infections and potentially other brain disorders.

RNAi AS A POTENTIAL MECHANISM OF ANTIVIRAL IMMUNITY IN NEURONS

Innate immunity has been demonstrated as a way to protect against bacterial and fungal infections through *Toll* signaling and immune deficiency (*Imd*) pathways. RNA interference (RNAi) was more recently demonstrated as a mechanism to protect against viral infection; however it is uncertain which cell types can employ RNAi as an immune mechanism against viruses. To test if neurons can use RNAi to counter virus infection, we used neuronal cells from *Drosophila melanogaster* (fruit fly) lines that have specific loss-of-function mutations in genes that control RNAi activity — *Dicer-2* and *Argonaute-2*. Mutations in *Dicer-2* or *Argonaute-2* were predicted to increase neuronal susceptibility to infection by the neurotropic virus, vesicular stomatitis virus (VSV). We utilized a VSV strain genetically engineered to express green fluorescent protein (GFP) to allow us to monitor cellular infection via fluorescent microscopy. Baby hamster kidney (BHK) cells were used to generate VSV stock and quantification of VSV stock was performed via plaque assay with Vero cells. This study will better define immune properties of neurons and the nervous system, which may lead to improved therapies for neuronal disorders and infections.

Board 21

CATIE BEACH

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

I illustrated eight species of the pantropical tree genus *Xylopia* from the Annonaceae family in seven hand-drawn pen and ink plates this summer. Four of the plants are species new to science, others are poorly described in the scientific literature. The drawings replicate plant parts observed from a variety of specimens, depicting the unique traits, textures, and morphology of the specimens with technical accuracy. This technical detail, paired with the diagrammatic simplicity of line work, provides a visual aid for taxonomic research.

BOTANICAL ILLUSTRATION OF *XYLOPIA* SPECIES

The format of botanical illustration is a familiar visual vernacular to many in the Western world — hiding in wallpaper, coffee table books, and Hawaiian shirts. While these detailed diagrams are aesthetically pleasing to many, perhaps due to our affinity for flowers, they are inspired by an ancient scientific method of documenting and cataloging plant species. The known history of plant illustration dates back 4,000 years to the temple friezes of the first agricultural Egyptian and Mesopotamian civilizations.

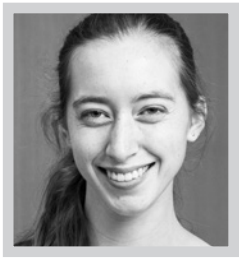
The act of documenting and illustrating plant functions and appearances became vital to agrarian survival, advancing into book form called herbals during the rise of Greek and Roman civilizations. Herbals became the standard encyclopedia of plant data collection: an early union of art and biology. As print technology advanced the traditional methods of hand drawing and coloring were outdated and replaced by the increasingly efficient printing methods of woodcut, etching, and lithography while retaining the tradition of artful rendering.

In today's digital age, with diverse print media options available, hand-drawn pen and ink illustrations remain the preferred method of visual understanding in a discipline fixed on understanding biological diversity and evolution. I worked with fragile dried specimens borrowed from museum collections around the world. A drawing tube attached to a microscope aided the accuracy of the drawings by allowing me to trace details of the specimen to ensure correct proportions. I composed the details observed and drawn from a variety of specimens onto a single plate and inked the drawings. I labeled each drawing, and indicated the scale for each detail.

I illustrated eight species of the pantropical tree genus *Xylopia* from the Annonaceae family in seven plates. Four of the plants are species new to science, others are poorly described in the scientific literature. The drawings depict the unique traits, textures, and morphology of the specimens with technical accuracy. This technical detail, paired with the diagrammatic simplicity of line work, provides a visual aid for taxonomic research.

Board 22

EMILY WEBB



Faculty Mentor: Shala Hankison
Department of Zoology

I am studying why Cedar Waxwings, a North American bird species, which normally eat fruit, would eat flower petals only during the month of May. I am looking at basic nutrients contained within flower petals and comparing them to basic nutrients contained within fruit to figure out why flowers would be substituted for fruit in their diet for only one month. I hypothesize that it is a combination of factors primarily involving the fundamental differences between Cedar Waxwings and other North American frugivores such as the American Robin.

A CHEMICAL ANALYSIS OF FLOWER-EATING BEHAVIOR IN CEDAR WAXWINGS

Flower-eating behavior is understudied even in tropical locations where the consumption of flower parts is more common. Cedar Waxwings (*Bombycilla cedrorum*) are the only species of North American frugivores that are known to consume flower petals. This study analyzed the nutritional value of flower petals from apple trees (*Malus domestica*) by examining the relative content of biologically important macromolecules including protein, sugar, phenolic compounds, and active antioxidants. Low protein in flower petals (4.5mg protein/g dry petals) combined with more than sufficient protein levels in anthers (22.2mg protein/g dry anthers) of apple blossoms suggest that the combination of these flower parts would be comparable to that of a fruit diet (2.15mg protein/g dry fruit), keeping in mind that more grams of fruit can be consumed in a minute than flower petals and anthers. The relatively high concentrations of sucrose (199.7mg sucrose/g dry petals) present in flower petals also suggests why no other frugivore in North America has been seen exhibiting this behavior, since Cedar Waxwings have the ability to digest sucrose and other frugivores such as the American Robin do not. Flower petals also have antioxidant activity comparable to that of ascorbic acid (82%). These factors combined can be used to begin to elucidate the evolutionary mechanisms behind opportunistic florivory during the month of May in Cedar Waxwings as well as florivory in tropical species for which it might be a greater portion of the diet.

JEMIL AHMED

Faculty Mentor: Suren Ambegaokar
Department of Botany and Microbiology

The spice turmeric has been shown to to prevent inflammation and lower risk of brain disease.Recent evidence has shown that turmeric inhibits influenza and hepatitis C viral infections.Our work will assess the effects of different turmeric concentration on laboratory grown African green monkey kidney cell line (Vero cells) when they are infected with Vesicular Stomatitis Virus. Understanding how turmeric inhibits viruses can help us identify a drug target for viral infections.

ANTIVIRAL PROPERTIES OF CURCUMIN

Curcumin is a polyphenolic extract from the spice turmeric. Previous research on curcumin indicates a variety of pharmacological benefits, including anti-inflammatory, antioxidant and antiviral activities. Our research uses Vero cells (a cell line derived from African green monkey kidney cells) infected with vesicular stomatitis virus (VSV), a rhabdovirus. VSV can infect and cause severe illness in many important livestock, such as horses, cattle, and sheep. Our preliminary data suggests that infection was reduced significantly in cells treated with curcumin. VSV infection induces oxidative stress to promote apoptosis to cause cell lysis, thus allowing the release of newly replicated virus particles. Future work will investigate if the antiviral effect of curcumin is mediated by reducing oxidative stress. This work will better inform our understanding of VSV pathology, and the potential use of curcumin as an antiviral therapeutic.

Board 23

LAUREN KIEBLER
(PRINCIPAL APPLICANT)

EMILY WEBB
(CO-APPLICANT)

OHIO WESLEYAN UNIVERSITY
THEORY-TO-PRACTICE GRANT

CONSERVATION AND MONITORING OF GREEN SEA TURTLES AND NEOTROPICAL BIRDS IN TORTUGUERO, COSTA RICA

We worked with the Sea Turtle Conservancy (STC) in Tortuguero, Costa Rica to monitor reproductive success and population dynamics of marine turtles, which includes Green Sea Turtles (*Chelonia mydas*), Hawksbill Sea Turtles (*Eretmochelys imbricata*), and Loggerhead Sea Turtles (*Caretta caretta*) in decreasing order of abundance. We also monitored population dynamics of resident Neotropical bird species. We accomplished this by assisting with marine turtle tagging, morphometric data collecting, body condition inspecting, nest tracking and excavation as well as avian banding and morphometric data collecting. In the two weeks we participated in this study, the STC in Tortuguero processed 58 Green Sea Turtles, one Hawksbill Sea Turtle, and one Loggerhead Sea Turtle. Of this sample, ten marine nests were marked for monitoring, including both the Hawksbill Sea Turtle and the Loggerhead Sea Turtle. During avian surveys, we set up an average of 5 mist nets per day and captured a total of 18 birds and 8 different species. We conclude that Green Sea Turtles in Tortuguero, Costa Rica maintain a relatively stable population, but other marine turtle species struggle to do so. More work needs to be done to reach out to local schools, reduce light pollution, and prevent poaching both in Tortuguero, Costa Rica, as well as in other key nesting sites. The population dynamics of the birds captured during this study agrees with previous findings with regard to population structure of Neotropical birds in secondary forest fragments.

Board 24

KAMALI JONES

Faculty Mentor: Kei Minamisono
Department of NSCL/Michigan State University, Dep. Physics and Astronomy

Our group studies nuclear properties of low energy rare isotope beams. This particular study investigated ^{45}ScII, an ionized beam of the stable ^{45}Sc isotope, in order to prepare for experiments on radioactive ^{40,41}Sc. We measured hyperfine parameters of two atomic states. When compared to previous data, our measurements had smaller error, suggesting that we are prepared for the radioactive experiment.

HYPERFINE STRUCTURE MEASUREMENTS OF ^{45}SC

A chain of charge radii shows discontinuity at nucleon magic numbers. This for Ar, Ca and K isotopes. A collinear laser spectroscopy experiment on the stable ^{45}Sc isotope, which is one proton added to Ca, was performed as a to further investigate the abnormal behavior. The experiment was performed at BEam COoling and LAser spectroscopy (BECOLA) facility at NSCL and a nm in ^{45}ScII. The magnetic dipole and electric quadrupole hyperfine coupling constants *A* and *B* of both the lower and upper states were obtained from the hyperfine structure by fitting a pseudo-Voigt profile. The results obtained from these data are in good agreement with previous values. However, these experiments yielded smaller statistical errors.

Board 25

SARA SCINTO

Faculty Mentor: Suzanne Johanningsmeier
Department of Food, Bioprocessing, and Nutrition Sciences at
North Carolina State University

My project focused on developing a vegetable preservation method that would allow for supply of a healthy, value-added vegetable product for a longer period of time to a greater population. Vegetables commonly wasted at the farm and supermarket were obtained from three local grocery stores, subjected to three different treatments, blended with a salty brine, and fermented at room temperature for one week. More vegetables should be surveyed, but data suggests that end of shelf life surplus vegetables can conveniently be preserved by fermentation within 3 days (if bacterial cultures are added) with minimal equipment and ingredients.

CONVERTING END OF SHELF LIFE SURPLUS VEGETABLES INTO VALUE-ADDED FERMENTED VEGETABLE PRODUCTS

As efforts toward feeding a growing population increase, food waste reduction may be achieved through preservation methods such as fermentation to create novel, value-added products. Conventional lactic acid fermentation methods were applied to five commonly wasted vegetables at the farm and retail levels: sweet potatoes, collard greens, zucchini, bell peppers, and tomatoes. Vegetables were obtained from three sources and randomly assigned to three treatments: raw and non-inoculated (natural fermentation), raw and inoculated, and blanched and inoculated. Freeze-dried *Lactobacillus plantarum* starter culture was added at a concentration of $1x10^6$ cfu/g. All samples were mixed with cover solution to achieve an equilibrated concentration of 0.1% w/w potassium sorbate, 1.2% w/w NaCl, 0.8% w/w KCl, 0.33% w/w $CaCl_2$, and 0.19% w/w $MgCl_2$, pulverized, and divided into tubes corresponding to six time points. Samples were fermented for one week at ambient temperature and stored at -80 °C until analysis. Changes in sugars, organic acids, ethanol, spoilage, preservatives, and folate were quantified by HPLC and UHPLC analyses. Color and pH were quantified to assess product quality and fermentation progress. Fermentation was successful in all vegetables, indicated by lower pH values ($p<0.0001$), higher lactic acid levels ($p<0.0270$), and a trend of higher fructose and glucose levels. Inoculation decreased the time needed to reach equilibrium pH in all vegetables ($p<0.0010$) except zucchini. The green color of zucchini and collard greens decreased during fermentation ($p<0.0001$). Blanching was only beneficial for maintaining characteristic sweet potato color ($p<0.0002$) and possibly preventing spoilage development. No 5-methylfolate was detectable in the limited samples tested. Preliminary results indicate this method could be refined into an optimal, simple procedure of preservation for a wide range of surplus produce to help satisfy global demand for nutritious food.

Board 26

JOCELYNE MUÑOZ

Faculty Mentor: Shari R. Speer
Department of Linguisitics, The Ohio State University

This experiment extends work in psycholinguistics to explore listeners' use of intonation in spoken word processing during object identification. Using a head-mounted eye-tracker, eye fixation patterns were observed in order to compare participants' comprehension of word sequences with felicitous vs. infelicitous pitch accent sequences in spontaneous vs. laboratory speech. Results demonstrate that felicitous pitch accent sequences facilitate spoken language processing for both lab and spontaneous speech.

THE EFFECT OF PROSODIC TUNE ON OBJECT LOCALIZATION

Previous work in psycholinguistics with laboratory speech (Ito & Speer, 2008; 2011) has shown that listeners can use appropriate contrast-marking intonation on an adjective, such as in the sequence 'blue ball, GREEN ball,' to anticipate an upcoming noun. The current experiment extends this work to explore the role played by prosodic tunes (differences in e.g. fundamental frequency, duration and spectral information that give rise to perceived rhythm, stress, and timing sequences in spoken language) in language comprehension, comparing laboratory and spontaneous speech. The anticipatory speed with which a named object is visually located was compared for felicitous (L+H*0) vs. neutral (L+H*0) tunes and for spontaneous vs. laboratory speech. COSI guests who were native English speaking adults volunteered to participate in a holiday-tree decoration task. Visual stimuli were real-world objects: six ornament types in eight colors presented in an array organized by ornament type. Auditory stimuli were pre-recorded adjective-noun pairs heard over noise-canceling headphones. Participants heard an ornament name, located it in the array, and placed it on miniature tree while a head-mounted eye-tracker was used to monitor their gaze. Results indicated that felicitous pitch contrast speeded looks to the named target as compared to the neutral tune. This was the case for spontaneous speech as well as carefully created lab speech: No differences between eye movement patterns for lab vs. spontaneous speech were found. Comparison of prosodic tunes demonstrated that a felicitous contrastive accent facilitated processing; a misleading contrastive accent 'garden-pathed' the listener. For both types of speech, L+H*0 tunes on contrastive sequences allowed participants to locate the target ornament more often and earlier as compared to H*!H* sequences.

Board 27

ZACH CLAYTOR

Faculty Mentors: Peter Capak, Dan Masters
Infrared Processing and Analysis Center,
California Institute of Technology

The brightness of galaxies was measured for multiple colors, and then the galaxies were placed in a computer-driven, topographical map near ones with similar color. To analyze how errors in the color data affect the layout of the map, each galaxy's colors were scattered about their values within their uncertainties, and then the galaxies were placed back onto the map. As long as there was uncertainty associated with the color measurements, scatter remained low. However, missing uncertainties caused larger scatter in the map.

DETECTING BIAS IN A SELF-ORGANIZING MAP OF GALAXY PHOTOMETRY DATA

The Wide-Field InfraRed Survey Telescope (WFIRST) will measure distances to billions of galaxies using photometry, but a spectroscopic calibration must be performed to acquire the necessary precision. In order to estimate the minimum spectroscopy WFIRST will need, tools were developed to analyze a Self-Organizing Map (SOM), a two-dimensional representation of higher-dimensional galaxy photometry. Using these tools, Monte Carlo simulations were performed using different regions of a SOM to see how photometric error affected the layout of the map. While data sets with recorded photometric error usually had less than 5 pixels of scatter on a 75 x 150 pixel^2 map, data with missing errors caused more scatter. This lays the groundwork for estimating WFIRST's spectroscopic requirement. Continuation of this work will build on the existing tools to predict what amount of spectroscopy will decrease the error in the map to the required precision, while future work should attempt to adjust for missing measurements in the data.

Board 28

N'TOIA HAWKINS

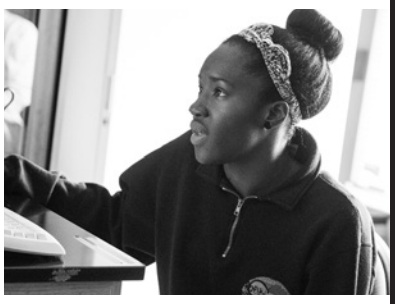
Faculty Mentor: Elaine Sia
Department of Biology at the University of Rochester

Deletions of direct repeats in the mitochondrial genome are common in human cells. Currently how these deletions arise is unknown. Deletion events lead to mitochondrial instability and have been associated with several types of cancer, neurological disorders, and may contribute to aging. Our lab wanted to investigate the role of the protein, irc3, as it relates to recombination and repair of said deletions in mitochondrial DNA

IRC3 CAUSES INSTABILITY IN THE MITOCHONDRIAL GENOME

The mitochondria organelles in eukaryotic cells are vital to energy production. Mitochondria contain their own unique independently maintained genome that, when mutated, causes detrimental effects on the cell such as respiration loss. This study investigated some of the proteins that are involved in mitochondrial recombination and maintenance. More specifically, IRC3p, an ATPase and putative helicase. Irc3 mutant strains were found to have a significant impact on respiration, recombination, and morphology of the mitochondria. These drastic changes in the mitochondria suggest that IRC3 is vital for the stability and maintenance of the mitochondrial genome in yeast.



Board 29

LARYNN CUTSHAW AND NADYA SOTNYCHUK

Faculty Mentors: Laura Tuhela-Reuning[1,2] and Edward H. Burtt, Jr.[2]
[1]Department of Botany and Microbiology, OWU;
[2]Department of Zoology, OWU

We travelled to Victoria, Australia to collect bacterial and feather samples from birds of 27 species and 301 individuals. We formulated several studies to a) compare the prevalence of microbes globally; b) evaluate the correlation between feather pigments and their likelihood as hosts for microbes; and c) examine the effects of capture methods on microbe counts. The statistical analysis of the data will continue into 2016.

UNDERSTANDING THE GLOBAL PREVALENCE OF PLUMAGE MICROBES

Bird plumage is an ecosystem of microbes — bacteria, fungi, and yeasts live in symbiosis with an avian host. Previous studies have proven that the prevalence of these microbes is variant based on geography and habitat type within the U.S. Additionally, it is recognized that different feather pigments offer greater resistance to decomposition caused by feather-degrading bacteria. Furthermore, most of these microbes are soil-dwelling, indicating that birds with more soil contact will have higher microbial loads. This information led to the formulation of several studies that were carried out in Victoria, Australia. Bacterial and feather samples were taken from 301 birds of 27 species to a) compare the prevalence of microbes globally; b) evaluate the correlation between feather pigments and their likelihood as hosts for microbes; and c) examine the effects of capture methods on microbe counts. We hypothesize that birds captured in the humid habitats of Victoria will demonstrate greater microbial loads than those of North American caught birds. We also suspect feather pigment will significantly correlate with microbial load; we predict feathers with greater amounts of melanin and carotenoids will have a higher microbial abundance. Additionally, we assume capture methods are a factor in microbial load. We expect microbial abundance of birds captured with mist nets, a device used to catch the birds in flight, will have lower abundance than those captured with snap traps, a tool which restrains the bird into the soil. These studies will continue into 2016 as we statistically process this data.

Board 30

AAINA GUPTA

Faculty Mentors: Ashok Kumar and Nitin Puri
Department of Physiology and Pharmacology, University of Toledo

Our lab focused on human hypertension, which lead us to study the RAAS system. This system regulates our blood pressure and we studied some possible effects that could lead to blood pressure. Through our research, we saw that certain DNA sequences and aging can possibly lead to an increased risk of human hypertension.

HAPLOTYPE MEDIATED TRANSCRIPTIONAL REGULATION OF HUMAN ANGIOTENSIN TYPE 1 RECEPTOR (HAT_1R) GENE

Hypertension is a complex genetic disease. It's a cardiovascular risk factor for myocardial infarction, vascular disease, stroke, & renal failure. In the US, about 78 million adults have high blood pressure. Age-associated inflammation and redox imbalance underlie etiopathogenesis of cardiovascular-renal diseases. The age-associated structure and functional change is linked to coronary and cerebro-microvascular blood flow and development of cardiovascular diseases. Through the renin-angiotensin-aldosterone system (RAAS), angiotensin II activates angiotensin type 1 receptor (AT1R), which leads to the formation and progression of diseases, and angiotensin type 2 receptor (AT2R). It is known that human AT1R is a vaso-constrictor & hAT2R is a vaso-dilator. AT1R is the principal mediator of the aforementioned physiological effects of ANGII in mammalian adults, and evidence shows AT1R leads to cardiovascular pathologies. Aging animals show there is an altered response in the RAAS system. The invitro study results show increased basal promoter activity of the hAT1R gene in cells (H295R and A7r5) transfected with reporter construct containing haplotype I. Two haplotype blocks of single nucleotide polymorphisms were found in the hAT1R gene: haplotype I & II. Hap I is linked to human hypertension. This study examines haplotype-dependent and age-associated transcriptional regulation of the hAT1R gene. Transgenic mice were engineered with either haplotype of the hAT1R gene using a 166-kb BAC. Aged (>18 months) male mice were used for this study. hAT1R expression increases with age in both haplotypes; however, this increase is much higher in Hap I than Hap II. From the studies, it can be concluded that haplotype I has a higher risk for human hypertension. Also, transcriptional regulation of the hAT1R gene is different for both haplotypes. Lastly, aging has an increased effect on the transcriptional regulation of haplotype 1 of the hAT1R expression.

Board 31

ARIA DOCKHAM

Faculty Mentor: Laura Wagner
Department of Psychology, The Ohio State University

5-year-olds can understand telicity in their native language, Wagner (2006), and adults are able to detect telicity in sign languages, but can 5-year-olds can detect telicity in sign languages? Some verbs have set endpoints, a word that shows a completed action (sell, die, forget), whereas other verbs have no set endpoints and these actions can continue on indefinitely (discuss, float, talk). Sign languages have been found to include these endpoints in their signs, so 5-year-olds were given a task to see if they could detect telicity in sign language.

IS TELICITY VISIBLE IN SIGN LANGUAGES?

Telicity is categorized in to two groups, atelic and telic verbs. Atelic verbs are words that do not have an endpoint, and can, theoretically, continue on indefinitely (ex. think, run, imagine). Telic verbs are words that have a specific endpoint and the events signify an end (ex. buy, decide, leave). Sign languages show telicity through repeated and continuous hand motions (atelic verbs) and through restricted hand motions showing a definite end point (telic verbs). Strickland et al. (2015) showed adults could significantly detect and distinguish iconic telicity in sign language. Can children detect telicity in sign language? Compared to adults, children do not have as much skill with problem solving or abstract thinking, as much experience with gestures or talking using their hands, or as advanced vocabularies. Is all this automatically learned and can they see iconic meanings in sign languages? 5-year-olds were shown videos with different verbs in Dutch sign language. With each video two word choices (one telic, one atelic) were given. The children were to choose which word choice they thought the video was signing, however neither of the word choices matched what the signed word in the video was. Children were supposed to match this based on telicity. Children were unable to detect telicity in this task, for the atelic verbs they got 0.467 correct, and for the telic verbs they got 0.514 correct, which is considered chance. Another experiment was done but this time one of the word options actually matched what the signed video was. Children succeeded at this task, for the atelic verbs they got 0.780 correct, and for the telic verbs they got 0.549 correct. Children succeed with the atelic verbs because they are physical verbs (run, float, talk, discuss), which they can see and do. 5-year-olds cannot detect telicity, but they succeeded at task 2 because of iconicity in sign languages, which they can detect and see.

Board 32

KYLE DAVIS

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

We were looking to see the effects of particle abrasion and bacterial degradation on feathers. This project is leading to a future project in which we look at the combined effect of abrasion and degradation on feathers.

COMBINED EFFECT OF ABRASION AND BACTERIAL DEGRADATION ON FEATHERS

Bacterial degradation of feathers (Burtt and Ichida. Auk 116:364-372.1999) and abrasive damage to the plumage by airborne particles (Burtt, Ornithol. Monogr. 38. 1976) have been described in general terms, but the contribution of each to feather damage is unknown. We studied the relative effects on central tail feathers from 40 House Sparrows (*Passer domesticus*). Fifteen feathers were exposed for 6 sec. to abrasion by particles of iron oxide carried in a high-pressure airstream. The distalmost one centimeter from each of 15 feathers was degraded in a suspension of feather-degrading bacilli at an optical density of 0.5 McFarland standards incubated at 37 C for 24 hours. Following treatment each feather was photographed in a scanning electron microscope at 119 times its normal size. The damage to the feathers was dramatically different. Abraded feathers remained substantially intact, but had significantly fewer barbules/barb after abrasion. Such damage would reduce the ability of barbs to lock onto each other. Following bacterial degradation the keratin of the feathers had separated into separate strands, which strongly suggests a complete loss of rigidity and, therefore, function. Both forms of wear seriously threaten the function of the plumage (e.g., insulation, aerodynamics) and therefore provide strong selection for evolution of adaptations that limit damage, for example hardening the feather with particulate pigments (e.g., melanin) and preening (e.g., removes bacilli from the plumage).

Board 33

ALEXANDRA COOK

Faculty Mentor: Ester Perales Clemente
Department of Regenerative Medicine at Mayo Clinic in Rochester, MN

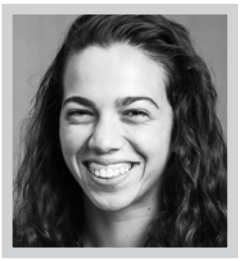
Our lab studied the relation between mutation in mitochondrial DNA and the physical response in cardiac progenitor cells. Skin cells were take from patients and reprogrammed into stem cells, which then were cultured into different lines of cardiac progenitor cells, each line having a different mutation. These cardiac progenitor cell lines were put through varies experiments in order to determine if the phenotypic variations, or sensitivity of the lines, were related to certain mutations found in the mitochondrial DNA.

DOXORUBICIN STRESS TEST IN CARDIAC PROGENITOR CELLS WITH AND WITHOUT MUTATIONS IN THE MITOCHONDRIAL DNA

Stem cells are an up and coming medical breakthrough in regenerative medicine. Their potential has been explored in a myriad of procedures, from heart defects to leukemia. The use of these stem cells with heart defects has been thought to mediate the effects of the defects by further strengthening the damaged and undamaged heart cells when injected into the heart. However, in order to successfully implement these cardiac cells into the hearts, possible issues that may occur with the stem cells of the patients and with the procedure needed to be explored in order to discover any problems that may hinder the utilization of the cardiac progenitor cells. Cell lines with different mitochondrial mutations were put through a stress test to determine if the lines were more sensitive due to the mutations. Six cell lines with various mitochondrial mutations were brought through the cardiac differentiation process. At day 5, half the plates were put through the stress test, while the other half was kept for quality control. Once the stress test was complete, the cells were collected, processed, and analyzed with Flow Cytometry, to determine the percentage of live and death cells. With this data, it was shown that one mutation in the cardiac progenitor cells (mt-rRNA^{Leu}) was significantly sensitive to the stress test, while the other mutations had various responses. Further research will be done by replicating this procedure on the same and other mutations to determine the levels of sensitivity in certain mitochondrial mutations. This will not only allow for a greater understanding behind the rolle of mDNA in stem cell differentiation, but also for better individualized patient care through regenerative medicine.

The NSF-funded REU (Research Experience for Undergraduates) program at Ohio Wesleyan makes it possible for students from universities across the country to do research in the fields of astronomy, computer science, mathematics, and physics on the OWU campus.

Board 34



GABRIELLA SILVA
CONNECTICUT COLLEGE

Faculty Mentor: Scott Linder
Department of Mathematics and Computer Science

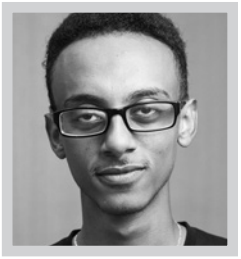
We examine how the sampling distribution of the sample correlation coefficient is affected by censoring. This sampling distribution is unknown but central to inference about relationships between two variables. We approximate these sampling distributions by fitting beta distributions to them, and then examine goodness of fit.

APPROXIMATE SAMPLING DISTRIBUTION OF THE SAMPLE CORRELATION COEFFICIENT UNDER TYPE II CENSORING IN A BIVARIATE NORMAL MODEL

We examine the sampling distribution of the sample correlation coefficient when a random sample of bivariate Normal random variates has been subjected to Type II censoring. This setting arises in industry. For example, we measure the mass of detached filament in the first 10 light bulbs that failed in an initial sample of 20 bulbs. In such settings, the sampling distributions of commonly used statistics are typically mathematically intractable and must be approximated. Here, we consider modeling of the sampling distribution of the sample correlation coefficient by a suitably scaled Beta distribution with parameters that are functions of the experimental conditions. We describe use of the Method of Moments approach to determining these parameters. We examine the overall goodness of fit of this approximating sampling distribution through the Chi Square test. Finally, we examine estimation of upper-tail percentiles of the sampling distribution obtained by this approximating Beta distribution.

We examine how the sampling distribution of the sample correlation coefficient is affected by censoring. This sampling distribution is unknown but central to inference about relationships between two variables. We approximate these sampling distributions by fitting beta distributions to them, and then examine goodness of fit.

ROBEL GEDA
RUTGERS UNIVERSITY



Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

Astronomers use computers to model and calculate relationships between physical properties of celestial objects. The data generated and manipulated can very large making the process time consuming. Nevertheless clever tricks can be used to overcome the time cost of the computations. One effective option would be to break the task up and distribute the job to multiple computers. This project aims to take advantage of this idea to reduce the time cost of processing data.

STELLAR SURFACE IMAGING VIA LIGHT CURVE INVERSION (LI)

A graphics processor unit (GPU) is a specialized electronic circuit originally developed for 3D game rendering. A GPU consists of multiple cores that are capable of preforming a given task independently which makes it an attractive tool for data processing. GPU-accelerated computing takes advantage of thousands of cores in the GPU to accelerate scientific and engineering calculations. This project aims to implement efficiently parallelized code into the Light-curve Inversion (LI) algorithm. LI is a computational technique used to map the surface of a star and model the evolution of its starspots over time. The software divides the surface of the star into a thousand equal-area patches and assumes that each patch is uniformly bright across its surface area. The calculation then determines a set of patch brightnesses such that the residual between the light curve they produce and the data light curve is equal to the estimated noise in the data. The computational run time was greatly reduced by dispatching multiple GPU processors and distributing the operation to each core.

COLTON PIPER
PLYMOUTH STATE UNIVERSITY

Faculty Mentor: Craig Jackson
Department of Mathematics and Computer Science

ANALYSIS OF CLIMATE FEEDBACKS: LOCAL VS NON-LOCAL EFFECTS

Feedbacks in the climate system are subprocess that tend to either amplify or suppress the climate's response to perturbation. When the feedback process amplifies the response then the feedback is said to be positive, whereas if it suppresses the response then it is said to be negative. There are many feedbacks in the climate system and the interaction of these feedbacks are what determines, to a large extent, the way in which the overall climate reacts to forcing (anthropogenic or otherwise).

Climate feedbacks are often studied in the context of a mathematical model of the climate system where the strength and sign of a given feedback process is computed by comparing the temperature anomalies that result from an applied forcing when the feedback is variously held fixed at the equilibrium value or allowed to freely react to the forcing. The ratio of these temperature anomalies is called the gain parameter of the feedback and is a measure of the strength of an individual feedback process.

One issue with this common approach, however, is that it can depend on the shape of the applied forcing. To overcome this, we investigate a new method of quantifying feedbacks that results in gain matrices which are independent of the applied forcing and which generalize the previously defined gain parameters. We apply this method to two particularly important feedback processes (the ice-albedo and water vapor feedbacks) as represented in two well-studied one-dimensional energy balance models that differ primarily in how the atmospheric heat transport is quantified. We see in both cases that the ice-albedo is more of a purely local feedback whereas the water vapor feedback has almost equal local and non-local contributions.

KATHERINE HOLMAN

PHYSICS, ASTRONOMY AND GEOSCIENCES DEPT., TOWSON UNIVERSITY

Faculty Mentor: Christian Fink
Department of Physics and Astronomy

Understanding types of neural activity that occur during seizures helps doctors treat epilepsy effectively. For decades, doctors assumed seizures were the result of overly synchronized neurons. While this is true for some seizures, new data suggests neurons fire asynchronously during many seizures. We ran simulations showing how seizure brainwaves can be produced by asynchronous neural activity.

SHAKING UP OUR UNDERSTANDING OF EPILEPSY

With new microelectrode technology, neuroscientists are able to measure the firing of individual neurons during human seizures. Recent data suggest that seizures, which were conventionally associated with hypersynchronous neural firing, may actually feature *asynchronous* neural firing. This study investigates how robustly a neuron cluster is able to produce narrow-band oscillations, which are discrete frequency components commonly found in seizures. We simulated a group of 100 neurons all firing asynchronously, but at similar frequencies. The sum of these individual neural activities produced aggregate electrical activity called the local field potential (LFP). Using statistical methods, we introduced differing levels of heterogeneity to neural spike timing. By analyzing the frequency content of LFPs, our results show how narrow-band oscillations may emerge from asynchronous neural activity and predict the maximum level of heterogeneity that allows this emergence. Our results shed light on the underlying mechanisms of seizures for the 30% of people living with drug-resistant epilepsy.

SAVANNAH GOWEN

MOUNT HOLYOKE COLLEGE

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

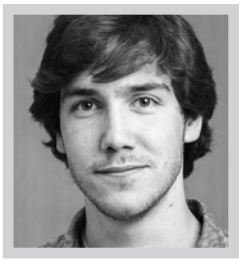
The nucleus remains a weakly understood entity to this day, although it is one of the fundamental building blocks of matter. However, despite the limitations of our understanding, discoveries made in nuclear physics have drastically changed human life. Innovations such as those made in nuclear warfare or in medical technologies such as MRI demonstrate this. This project explores specifically the unstable Arsenic 73 nucleus by investigation of its energy excitations and structure to improve our understanding of nuclear behavior.

SEARCHING FOR INTRUDER STATES IN ^{73}AS

High-spin excited states in ^{73}As were produced following the fusion-evaporation reaction of a 50-MeV ^{14}C projectile beam incident on a ^{62}Ni target using the John Fox Superconducting Accelerator facility at Florida State University. De-excitation gamma rays from ^{73}As were measured and identified in coincidence using a Compton-suppressed Ge array consisting of three clover detectors and seven single-crystal detectors. Based on the observed double- and triple-coincidence γ-ray spectra, the most recent level scheme of ^{73}As was modified to include the addition of 4 new transitions and the rearrangement of 9 others. The existence of a rare deformed structure based on the unpaired proton occupation of the intruder $f_{7/2}$ spherical orbital, observed in ^{71}As, has not been found in ^{73}As. The kinematic moments of inertia inferred from the energies and spins of the excited states in each observed rotational band indicate typical “backbending” behavior resulting from the spin alignment of a broken pair of like nucleons, similar to what was observed in ^{69}As and ^{71}As. Preliminary shell-model calculations for ^{73}As predict an excitation energy spectrum that is in better agreement with the experimental one at low energy than at higher energy.

T. DOBROW
DEPT. OF COMPUTER SCIENCE, MIDDLEBURY COLLEGE

Faculty Mentor: S. McCulloch
Department of Mathematics and
Computer Science



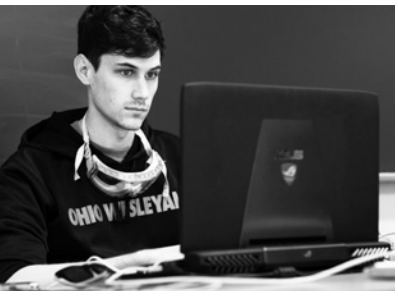
My research this summer was to create an intelligent agent that can play humans at the 2-player strategy board game Battle Line. In Battle Line players use "Troop Cards" of 10 values in 6 colors and specialty "Tactic Cards" to fight for control of 9 flags by building three-card poker hands (straights, flushes, triples, etc). Each turn, the agent evaluates each card in hand, and each possible placement, and determines which card maximizes its chances of winning that flag, and of winning the game. This is done using a probabilistic model that considers the chances of making and winning the best possible hands.

ARTIFICIAL INTELLIGENCE FOR THE MODERN BOARD GAME BATTLE LINE

The most common approach for designing intelligent agents that play turn-based board games has been using Game State Trees. However, when factors such as imperfect information and randomness are introduced, traversals through these trees become infeasible. Battle Line is a two player game in which players use a deck of "Troop Cards" of 10 values in 6 colors and specialty "Tactic Cards" to fight for control of 9 flags by building three-card poker hands (straights, flushes, 3 of a kind, etc), called *formations*. Players win once they have taken any 5 of the 9 flags, or any 3 adjacent flags. The randomness of card draw and the number of possible formations make for an intractably large number of game states. Previous REU students created an intelligent agent that used a probabilistic model to determine the chances of winning the game given each of its available options. This year we rewrote the gameplay logic, improving both quality and speed of computation. We made three large-scale changes. First, we adjusted the way the agent evaluates the probability of winning a given flag. Second, we made a new model for how the agent evaluates the probability of winning the game to find the right balance between the two different win conditions. Finally, we overhauled the Tactic Card logic to account for the benefits and special rules for each of the unique Tactic Cards. We avoided ad hoc or arbitrary logic as much as possible, relying instead on the agent's exploitation of the probabilistic underpinnings of the game to yield high quality moves.

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	Department	Supervising Professor	Title
Elder, Robert	PHYSICS	Robert Kaye-Haring	Evolution of Collectivity with Spin in 70As
Gorbett, Shane	ZOOL	Shala Hankison	Impact of male: female ratio on male mating behaviors in Poecilia latipinna (Sailfin Molly)
Hupp, Brittany	GEOG/GEOL	Keith Mann	High Resolution Conodont Biostratigraphy of the Dundee Limestone, Michigan Basin
Katrinchak, Alexa	HHK	Nancy Knop	Using the Social Ecological model to Identify Strategies to Improve Physical Activity at a Small, Liberal Arts College
Keiser, Emily Concepts in	MFL	David Counselman	The Impact of Explicit L1 Knowledge on the Retention of Grammar Beginning L2 Students
Kent, Cody	ZOOL	Jed Burtt	A feather ecosystem; The prevalence of feather-degrading bacilli in the plumage of birds
Kumar, Arjun	ECON	Julide Yazar	Risk Attitudes and Individual Behavior in First and Second Price
Robison, Laura	ZOOL	Ramon Carreno	The Endoparasitic Community of Tree Swallows (Tachycineta bicolor) in Ohio
Simmons, Elizabeth	CLAS	Lee Fratantuono	The Animal Similes in Virgil's Aeneid
Young, Elaine	GEOG/GEOL	Karen Fryer	Evaluating the Tectonic History of the Chugach-Prince William Terrane Through Geochemistry and Petrography of the Orca Group Volcanic Rocks in Eastern Prince William Sound, Alaska





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

2014 SSRP PARTICIPANTS

CRISSANDRA DIGGES
Attending West Virginia School of Osteopathic Medicine.

JOHN PERANZI
Taking classes, studying for the MCAT, and applying to medical school.

JAYNE ACKERMAN
Taking courses and studying for the GRE, returning to OWU in the fall for her senior year of college, plans to apply to graduate school.

KRISTEN ASTORIAN
Working as a Scientific Information Analyst at Chemical Abstract Services, a subsidiary of the American Chemical Society.

KAITLYN KROPF
Training to become an EMT and attending graduate school at the University of Florida Biomedical Neuroscience Program.

DARA MARKUS
Conducting research funded through NASA in Chris Wolverton's lab at OWU.

TJ CLARK
Applying for research assistant positions in neuroscience.

2013 SSRP PARTICIPANTS

NIVEDITHA MANIVANNAN
Attending Saint Louis University School of Medicine.

LAURA ROBISON
Participating in a naturalist Internship at Walking Mountains Science Center in Avon, CO.

SHANE GORBETT
Worked at the Animal Encounters Village at the Columbus Zoo and Aquarium and will be doing a research internship at the Duke Lemur Center and Myakka City Reserve.

CODY KENT
Completed a naturalist internship position with the Crawford Park District in Crawford Co. OH, and is beginning a PhD program in graduate school at Tulane University studying population and community ecology in American Redstarts in Jamaica.

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Karen McNeal
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OWU/Aramark Housekeeping staff
Chartwells Dining Services
Office of Marketing and Communications
Faculty supervisors and student volunteers
Parents and guardians of student researchers

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