Patricia Belt Conrades

September 18, 2017

Summer Science Research Symposium

Ohio Wesleyan University

MADELINE VROOM, OWU '16

Graduate Student, Department of Microbiology & Cell Science
Space Life Science Lab, University of Florida

"The research I did as an OWU undergraduate steeled my resolve to pursue a Ph.D. and helped prepare me for the rigor of graduate school. First-hand experience with critical thought and experimental design, combined with the ability to work independently, put me ahead of the curve my first year in a big way, and I use the laboratory skills honed over the months of my OWU summer research in my graduate studies every day."

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-fifth 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 18, 2017, at noon

Opening remarks by President Rock Jones followed by student poster presentations

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
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 26 students who performed research at OWU mentored by OWU faculty members, 7 students from universities other than OWU who worked on campus with OWU faculty, and 5 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 Associate 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, which 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 ACKNOWLEDGEMENTS

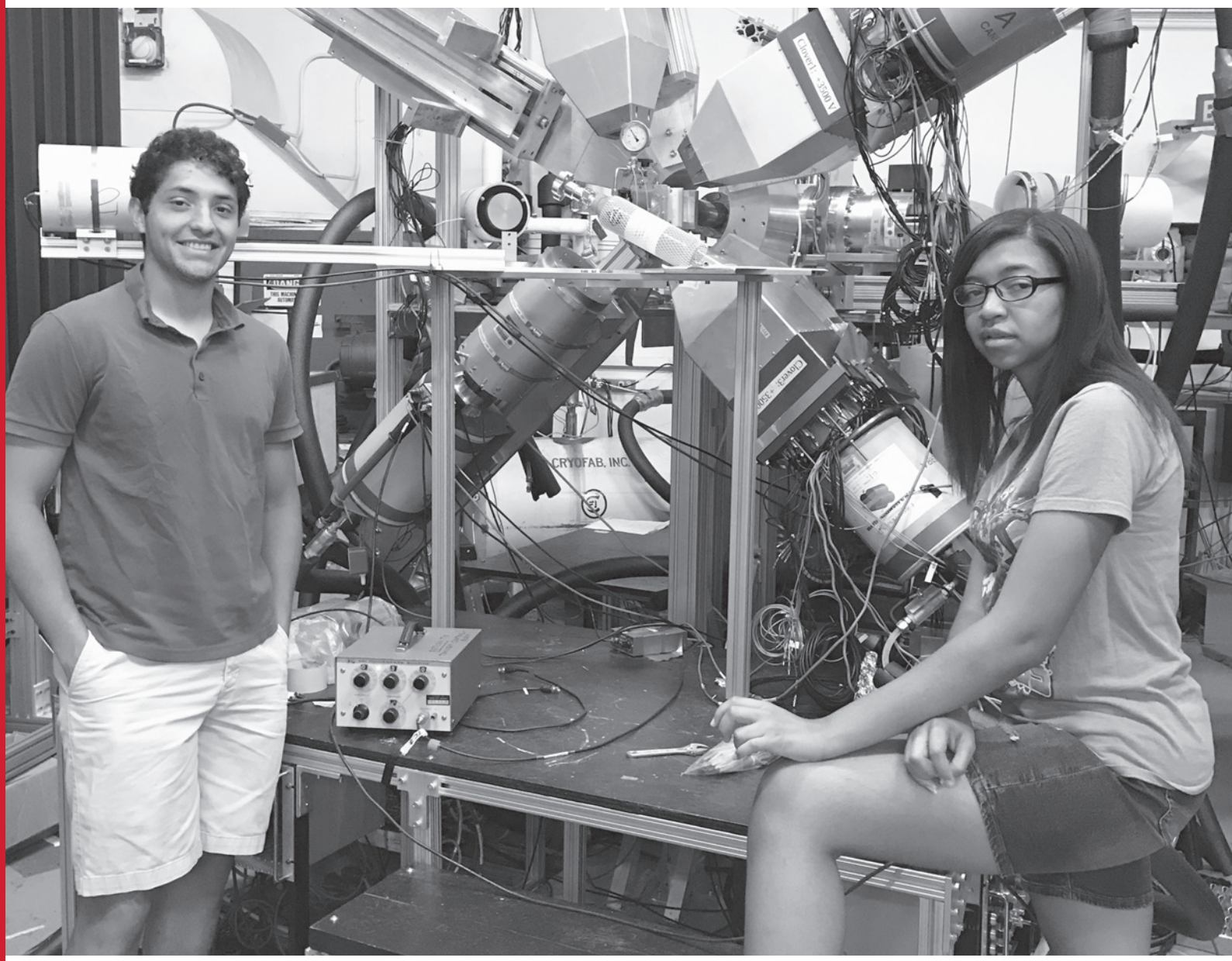
Sources of Support for the 2017 Summer Science Research Program

Harry Phillip Bahrick Summer Research Fund
Joseph H. '30 and Elizabeth Brant Collaborative Research Fund
Eleanor Brown Summer of Science Research Endowment
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
Ronald A. Mischler '69
Anne E. Donnelly '75
Ralph A. Herms '55
Karl C. Kuivinen '71 and Linda Russell Kuivinen

Support for the Patricia Belt Conrades Summer Science Research Symposium

Dr. Nancy Reynolds Schneider '64

Students conducting research on the OWU campus this summer were funded primarily through the OWU Summer Science Research Program (SSRP), but through a variety of other sources as well. Two additional funding grants for students came from the National Science Foundation-Research Experience for Undergraduates (NSF-REU) program: one to the Departments of Physics/Astronomy and Mathematics/Computer Science and a second to the Neuroscience Program. In the following pages, students listed were part of the SSRP unless otherwise noted.



Diego Venegas Vargas, from OWU, is supported by the Summer Science Research Symposium, and Brianna Harbin, a student from Northern Kentucky University, is funded by the Research Experience for Undergraduates program of the National Science Foundation.

Board 1

ERIKA SHULTZ

Faculty Mentor: Kira Bailey
Department of Psychology

The Dual Mechanisms of Control theory states that people switch between two different types of control — proactive and reactive — based on what they're currently doing in order to achieve their goals. These methods of control are associated with different types of brain activity. The current study aimed to reproduce and expand upon previous work by examining a specific type of electrical activity linked to proactive control in three different laboratory tasks. Because the specific activity was produced by all three tasks, its connection to the use of proactive control was strengthened which provided further support for researchers investigating goal-related brain functions.

SLOW WAVE ACTIVITY AS A MARKER OF PROACTIVE CONTROL

The Dual Mechanisms of Control theory proposes that individuals flexibly alternate between two modes of control — reactive and proactive — based on current task demands (Braver, 2012). In imaging studies, reactive control is correlated with transient activity in the lateral prefrontal cortex (PFC) and the anterior cingulate cortex, while proactive control is associated with sustained activity in the lateral PFC. Research using event¬-related potentials (ERPs) has identified the frontal slow wave (FSW) as a neural marker of proactive control (Bailey, West, & Anderson, 2010; West & Bailey, 2012; West et al., 2012). The current study aimed to replicated and extend previous work by examining slow wave activity in three different tasks: the counting Stroop, N-back, and flanker tasks. Participants completed the three tasks while EEG was recorded. Stimulus and response-locked slow waves were present across all three tasks, further supporting its association with the implementation of proactive control.

Board 2

CHRISTOPHER PESSELL

Faculty Mentor:
Nathan Amador Rowley
Department of Geology
and Geography

I am studying the growth of supraglacial lakes in the West Central ablation zone (or melting zone) of the Greenland Ice Sheet. The project's goal was to better understand the relationship between surface air temperatures and the observed meltwater filling topographic depressions, forming lakes. The volumes of five lakes were calculated using Remote Sensing techniques. A positive degree day model was applied to temperature data to calculate the volume of meltwater produced at temperatures over 0°C. Among the five supraglacial lakes, eight instances of growth were recorded.

PRODUCTION AND ROUTING OF SURFACE MELTWATER ON THE GREENLAND ICE SHEET ABLATION ZONE

Enhanced glacial melt has been observed across the Greenland Ice Sheet (GrIS), including the Ilullisat Glacier (commonly known as Jakobshavn Isbrae) over the past few decades. This increased glacier meltwater channelizes across the surface to form supraglacial melt lakes in topographic depressions. Surface melt across the ablation zone (or melt zone) of the GrIS is driven by near-surface air temperature above the melting point (0°C). We have identified five supraglacial lakes in the ablation zone that form regularly over subsequent melt seasons, and are in close proximity to a Greenland Climate Network (GC-Net) automated weather station (AWS). The catchment area for these lakes are defined by a high-resolution digital elevation model (DEM). Among the five supraglacial lakes, eight instances of growth were recorded. We apply the Positive Degree Day (PDD) model to the catchment areas to model the production of surface meltwater in the basin over the period of melt lake growth. The modeled results are then compared to the growth in supraglacial melt lake sizes from acquired Landsat-8 imagery over a period of two years.

Board 3

KELLY V. SUMMERS

Faculty Mentor: Dustin Reichard
Department of Zoology

Pet animals may experience stress when held, which can threaten their health and well-being. We examined whether handling by humans and the presence of stressed members in a social group affects the concentrations of a stress hormone found in the blood of captive budgerigars, a common pet bird. We expect that both handled birds and other members of their social group will show higher levels of the stress hormone after human contact. Therefore, in order to promote the longevity of your pet bird, we suggest avoiding unsolicited contact.

THE EFFECTS OF SOCIAL STRESS, HUMAN PRESENCE, AND HANDLING ON CIRCULATING CORTICOSTERONE LEVELS IN CAPTIVE BUDGERIGARS (*MELOPSITTACUS UNDULATUS*)

Budgerigars (*Melopsittacus undulatus*) are common household pets submitted to unsolicited handling that may ultimately threaten their health and well-being. Handling birds can result in the release of corticosterone — a hormone comparable to that of cortisol in humans, which regulates metabolic and stress signal cascades. Long-term exposure to corticosterone has been shown to compromise a bird's ability to grow feathers during the molt by inhibiting the production of proteins essential for feather production. However, previous research has failed to examine the corticosterone levels in captive parakeets when exposed to handling stress and whether the effects of such stress can also induce the stress response in other members of a social group. Nine captive female parakeets were organized randomly into groups of three. The central member of each group was removed, stressed by handling and plasma sampling, and returned to the group. After a period of reacclimating, plasma samples were taken from the two remaining focal birds. We predict that corticosterone levels will increase in response to handling as well as the injury and behavioral stress exhibited by another group member.

Board 4

FELISE BLOODGOOD
ALEC MARTIN
KYLE PELLEGRIN

Faculty Mentor: Robert Harmon
Department of Physics and Astronomy

A better understanding of starspots, which are cooler, darker regions on a star's surface caused by strong magnetic fields, gives a better understanding of how other stars and our Sun create their magnetic fields. Starspots can be detected by changes in the brightness of the star as the spots rotate into and out of our view. We observed a young star called LO Pegasi in order to produce a computer model of the locations of its spots based on its brightness variations.

STELLAR SURFACE IMAGING VIA LIGHT CURVE INVERSION (LI)

LO Pegasi is a young K3 main-sequence star that rotates with a period of 10.1538 hours at a distance of 81 light years. Rapid rotation creates strong magnetic fields that suppress convection in the star's outer layer causing regions to become cooler and thus dimmer than the surrounding surface. These cooler, dimmer regions are known as starspots, and are analogous to the sunspots our own star exhibits. As a starspot rotates into view, the total measured brightness will decrease until the starspot is most directly facing Earth and then increase as the starspot rotates out of view. This periodic dimming and brightening of the star provides information about the starspots on its surface. To measure the brightness of LO Pegasi, the technique of differential aperture photometry was utilized. This technique relies on comparing LO Pegasi to a standard star of constant brightness by using digital images taken with a CCD camera. For our observations we used a Quantum Scientific Instruments 632wsg camera attached to a Meade 14-inch LX600 telescope at Perkins Observatory in Delaware, OH and equipped with standard B, V, R, and I photometric filters. Observations of LO Pegasi began on 2017 June 1 and continued until 20 July. The resulting light curves that were then analyzed via the light curve inversion program created by one of us (Harmon) to produce surface maps. Our observations indicated that LO Pegasi's light curve changed in both amplitude and shape between 2017 June and July, while its maximum brightness did not change. We present maps corresponding to these two distinct light curves.

Board 5

KATIE VONDEREMBSE

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

I have created maps using the mapping software ArcGIS to display the distribution and diversity of Xylopia, a genus of flowering plants found in tropical areas across the globe. My maps focus on the forty-five Xylopia species of sub-Saharan Africa. These maps can be used to develop a better understanding of the evolution and classification of the genus, and develop conservation plans.

MAPPING *XYLOPIA* BIODIVERSITY IN SUB-SAHARAN AFRICA

Xylopia is a genus of flowering plant in the family Annonaceae. Its distribution spans the Neotropics, sub-Saharan Africa, Madagascar, tropical Asia, and Australasia east to Fiji. Africa is unique in that it is the only continent where all sections of *Xylopia* are represented. Researchers have compiled geographic data from plant collections going back over a hundred years to find the locations of the 45 *Xylopia* species in sub-Saharan Africa. Using this geographic data in the map-making software ArcGIS, I created maps to help analyze the distribution and diversity of *Xylopia*. Basic distribution maps, identifying the geographic locations of the plant collections, were prepared for all African species. Other maps show the distributions of sections and subsections within the genus. These maps enable researchers to study the relationships between characteristics of the plants and their geographic location. The distribution maps also enabled us to evaluate the threatened levels of 24 species with limited distributions by determining the Extent of Occurrence (EOO) and Area of Occupancy (AOO) as part of the procedure used in IUCN conservation assessments. A species richness map, in which the number of species was plotted for each one degree latitude by one degree longitude cell, shows the pattern for *Xylopia* on the continent. From these results we now know that the area of highest species richness lies along the Atlantic coast from southeastern Nigeria to northern Angola. An endemism map communicates how many *Xylopia* species are endemic, or defined to a certain geographic location. Using newly defined biogeographic regions, we found the area with the highest number of species to be the lowland wet forest Congolian Region containing nearly 47% of African *Xylopia* species. Using maps to portray the biogeographical data of African *Xylopia* may help develop a better understanding of this genus in regards to characteristics and classification, as well as for evaluating extinction risk.

Board 6

SERENA GEORGE

Faculty Mentor: Shala Hankison
Department of Zoology

We are observing the mating behavior of fish in an attempt to better understand why certain male behaviors or characteristics evolve and how this may lead to new species. Male sailfin mollies (*Poecilia latipinna*) compete for females by using aggressive behavior towards other males and by using their enlarged fins to attract females. To determine if certain male behaviors influence the amount of offspring that a male fathers, we are observing males attempting to mate with female sailfin mollies, then using genetic techniques to determine who fathered the most offspring and what mating strategy was most successful.

PATERNITY AND MATING BEHAVIORS IN THE SAILFIN MOLLY, *POECILIA LATIPINNA*

The emergence of male secondary sex characteristics and courtship behaviors may influence female mate choice and/or male-male competition. Male sailfin mollies (*Poecilia latipinna*) are an ideal study species for understanding how emerging traits and behaviors correlate to mating success because they have two distinct features: enlarged dorsal fins and courtship displays. Broods may have multiple fathers, and within these multiply-sired broods, there can be unequal representation of offspring sires. To determine if male behaviors correlate with mating success, we studied courtship behavior and paternity in *P. latipinna*. We conducted behavioral observations during which two size-matched males were introduced simultaneously to a receptive female. All courtship behaviors (sailfin displays, gonopodial thrusts, gonopodial nibbles) and dominance behaviors (sailfin displays, chasing, blocking, biting) were recorded using the software *The Observer XT 11*. In 20 broods, all females, potential sires, and offspring were genotyped using eight microsatellite loci, then the program *Colony* was used to determine paternity. Potential correlations between the frequency of certain male behaviors and the representation of offspring sires may lead to a better understanding of population divergence and speciation in this group of fishes.

Board 7

MADELEINE SORRICK

Faculty Mentor: Dustin Reichard
Department of Zoology

Our research focuses on better understanding the relationship between social interactions, circulating hormone levels, and aggressive behavior. Specifically, we are studying testosterone levels in response to aggressive behavior in two species of local songbird. Each bird is lured in a trial using a recording of another bird's song, and is then caught in a net to measure, band and take blood. The samples are then used to analyze the testosterone levels and determine if they increase along with the bird's aggressive behavior.

CHALLENGE ACCEPTED: ANALYSIS OF AGGRESSION AND HORMONE LEVELS IN CAROLINA AND HOUSE WRENS

According to the Challenge Hypothesis (Wingfield et al, 1989), organisms are predicted to respond to aggressive interactions with increased plasma testosterone levels, which can, in turn, facilitate aggressive behaviors. In seasonally breeding species testosterone levels rise during the breeding season, but the hypothesis proposes that during aggressive interactions, the levels rise higher to a maximum. To determine if this applies to two species of wren, male Carolina (*Thryothorus ludovicianus*) and House (*Troglodytes aedon*) wrens were exposed to simulated territorial intrusions using a playback of conspecific song. The bird's aggressive behaviors, such as dives and songs, as well as distance from the speaker were recorded throughout the trial. Fifteen minutes after the start of the playback, the male was caught as quickly as possible, and blood samples were taken from each bird. The plasma was extracted and will be used at a later date to analyze circulating hormone levels. A preliminary behavioral analysis suggests that House wrens sing more, approach more quickly, and are more active than Carolina wrens in response to playback. This data suggests that these two closely related species engage in very different aggressive behaviors and signaling. Whether differences exist in the testosterone levels remains to be seen. These behavioral differences may be due to the fact that Carolina wrens remain sedentary all year, whereas House wrens are migratory.

Board 8

AAINA GUPTA
PAIGE HAENIG

Faculty Mentor: Tami Panhuis
Department of Zoology

In the live-bearing fish *Poeciliopsis prolifica*, mothers transfer nutrients to their developing embryos using a placenta. To get a better understanding of placental structures involved in this nutrient exchange, we injected a fluorescently labeled glucose molecule into pregnant female fish. After a certain amount of time, we removed the embryos from sacrificed females to determine the location of glucose absorption using fluorescent microscopy. Results are pending modification of the protocol, but will allow us to better understand the relationship between placental function and structure.

FUNCTIONAL MORPHOLOGY OF THE PLACENTA IN *POECILIOPSIS PROLIFICA*

Teleost fish in the genus *Poeciliopsis* (Poeciliidae) give live birth, and in some species successful gestation of the embryo depends on a placental structure for continued maternal provisioning of nutrients. The specific placental features involved in maternal-fetal substance exchange have yet to be determined for *Poeciliopsis*. Our goal was to perform a functional analysis in *P. prolifica* that would trace nutrients from mother to embryo, as well as locate specific embryonic structures involved in nutrient absorption. We predicted that nutrients would be absorbed through the embryo surface epithelium of the body proper and/or sac. Research suggests that glucose has been successfully traced from mother to embryo. Using 2-(N-(7-Nitrobenz-2-oxa-1,3-diazol-4-yl)Amino)-2-Deoxyglucose (2-NBDG), a fluorescently labeled glucose molecule, we retro-orbitally injected pregnant females. The ovary and embryos were dissected out of sacrificed females after a predetermined amount of time, and viewed using fluorescent microscopy. Results are pending modification of the protocol. This study will give us a better understanding of the embryonic placental tissues, the relationship between placental function and structure, and enable us to perform comparative studies across *Poeciliopsis* species in the future.

Board 9

BENJAMIN WHITBOURN

Faculty Mentor: Danielle Hamill
Department of Zoology

The study of roundworms can be very beneficial to understand the complex process of animal development. One roundworm, *Caenorhabditis elegans*, is well described and can be used as a comparison for other animals. We are comparing four roundworms to *C. elegans* on a phenotypic and genetic level, discovering that we have at least one previously undescribed species. We have identified that several characteristics essential for establishing the anterior (head) to posterior (tail) axis in *C. elegans* do not occur in these worms. This research will provide insight into early development amongst roundworms and more distant species.

ANALYSIS OF CELL DIVISION AND DEVELOPMENT IN *C. ELEGANS* AND OTHER NEMATODES

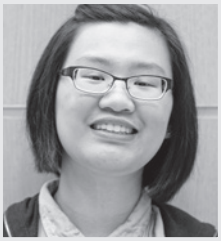
The roundworm *Caenorhabditis elegans* is a well-established model organism used for wide-ranging studies in cell biology, neurobiology, ecology and more. *C. elegans* is amongst millions of species, both described and undescribed, in the phylum Nematoda. We describe our progress on characterizing four nematodes isolated in Ohio and the Florida Everglades, some of which could be previously undescribed species. In this research we have studied the nematodes on a genetic level using select nuclear and mitochondrial genes. DNA sequence analysis demonstrated that we have been studying three distinct species in the genus *Oscheius*. Furthermore, we conducted phenotypic analysis of the worms and embryos using light microscopy and immunofluorescence. We found some interesting differences from *C. elegans* with regards to developmental patterns: *C. elegans* has distinctly asymmetric early cell divisions that are critical for normal development, but in the isolated worms some of these asymmetries were less pronounced. To further our characterization of these worms we are hoping to generate targeted DNA mutations and open new avenues for our research. Genome editing through CRISPR is an important area of research in many model organisms as it allows for the creation of precise DNA deletions or additions that can be very helpful in further characterizing undescribed species. We set out to develop tools and techniques for CRISPR with the goal of inactivating a collagen gene. So far we have attempted to amplify and determine the DNA sequence of a collagen gene in our worms, but more work is needed. In the future we hope to use these techniques to work with polarity genes and further address anterior and posterior formation. We believe the comparative studies like the ones described will enable us to obtain a better understanding of early development and developmental patterns in worms as well as other animals.

Board 10

TANIA LUO
UNIVERSITY OF NEVADA, RENO

LIZHEYIN WU
OHIO WESLEYAN UNIVERSITY

Faculty Mentor: Pamela Pyzza
Department of Mathematics and Computer Science



Using a mathematical model, we investigate how human papillomavirus (HPV) spreads through a population in order to gain insight into possible vaccination strategies. HPV is a common sexually transmitted infection that can cause many cancers. We model a network of individuals whose characteristics are drawn from existing studies about HPV. Based on that, we simulate the forming and breaking of relationships between individuals to study the propagation of the virus through the population over time.

MODELING THE SPREAD OF HPV THROUGH A NETWORK

Human papillomavirus (HPV) is a common sexually transmitted infection in both males and females, which usually shows no symptoms and can be transmitted through genital or oral sex. Among over one hundred strains of HPV, we focus on two high-risk strains that are responsible for a majority of cervical cancer cases leading to about 4,000 deaths in the United States per year. Using a dynamic agent-based network, the spread of HPV can be mathematically modeled and examined.

Our agent-based network consists of agents representing individuals with characteristics, such as age, biological sex, and sexual orientation, and links representing sexual connections formed based on the characteristics of the agents. Using a set of probabilistic rules, we can simulate the connections between individuals in the network. Once connections are established, HPV can spread based on the health status of the individuals. Since the network changes dynamically with respect to time, connections form and break, and older agents will age out of the network while new ones join. We can examine the propagation of HPV through the network, which can be used to investigate the properties of an endemic disease, like HPV, and effective vaccination campaigns against it.

Board 11

ALLIE EYNON (SHOWN)
SHELBY QUADE

Faculty Mentor: Lynda Hall
Department of Psychology

Our research seeks to improve understanding of factors that impact very long term memory for knowledge acquired in a college course. We are developing materials for an online memory test. We will ask alumni to complete the test to determine how much they remember from the Quantitative Methods class.

MAINTENANCE OF KNOWLEDGE

This summer our research was focused on background work for an investigation of very long term memory. No experimental investigations of semantic memory lasting over periods of years have been published because researchers cannot control for how the information was acquired, and it is extraordinarily difficult to follow the same participants over several decades. To overcome these obstacles, researchers use correlational designs and measure memory for information that has been acquired in naturalistic environments. For example, Bahrick and Hall (1991) studied very long term memory in people that took a high school algebra or geometry course. This was achieved by measuring acquisition variables (measures of what the participants initially learned); the retention interval; and rehearsal variables (measures of how much someone practiced what they learned). Bahrick and Hall were then able to model changes in memory over a fifty year time period as a function of the acquisition and rehearsal variables.

This summer, we prepared for an investigation of memory for material learned in the Psychology Department's Quantitative Methods course from 1992 to 2017. We have the final exams for over 1100 students, and we developed a database of performance on individual exam questions. Our eventual goal is to test the memory of former students who completed the course with online assessments. The analysis of the final exam questions will aid in development of memory tests that are short and focused. We also plan to identify groups of final exam questions that vary together and constitute subtests. We will determine if performance on these subtests can provide more precise measures of the students' initial acquisition of the material.

Board 12

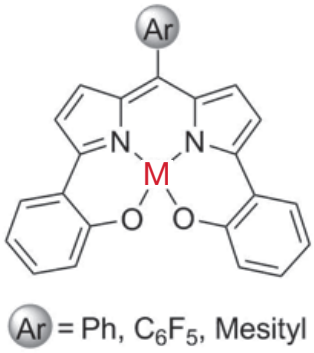
SARAH BERGMAN
JAMES ZOLLER
LAUREN BOEDICKER

Faculty Mentor: Allen Pistner
Department of Chemistry

We are developing a catalyst for producing an environmentally-friendly plastic called polylactide, which is used for making biodegradable packaging material and utensils. This catalyst will hopefully be cheaper than those currently used, and allow for greater control over the properties of the polymer. We are currently attempting two different synthetic pathways to try to find the more efficient route.

DEVELOPMENT OF A REDOX-ACTIVE LIGAND SCAFFOLD FOR THE ACTIVATION OF LACTIDE

A redox active ligand scaffold for the ring-opening polymerization of lactide was synthesized. The construction of the dipyrrin scaffold was approached with two separate synthetic pathways. The first approach begins with the Negishi-type cross coupling of an aryl halide with zincated pyrrole species, followed by the condensation with an aryl aldehyde to afford the dipyrrin structure. The second pathway uses a top-down approach, which begins with the condensation of pyrrole with an aryl aldehyde to form the dipyrromethane, followed by bromination at the α-positions. A Suzuki cross coupling reaction with an aryl boronic acid produces the dipyrrin ligand. Both approaches provide an opportunity to influence the electronic properties of the scaffold through the inclusion of electron-withdrawing or electron-donating aryl groups. Metal complexes will be synthesized and be fully characterized including catalytic activity for the ring-opening polymerization of lactide.



Board 13

DIEGO VENEGAS VARGAS

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

Rigorous studies in nuclear physics have led to important developments in a vast range of fields such as medicine with the magnetic resonance imaging technology (MRI), sources of energy with the implementation of nuclear power plants, and geology and archeology with the use of radiocarbon dating. Although there has been much progress in nuclear studies, many of the fundamental properties of the nucleus have yet to be fully comprehended, including the strong force that holds the nucleus together. An example of a nucleus in need of study is a neutron-rich isotope of gallium, ^{70}Ga, about which relatively little is known. The focus of this research project is to gain a better understanding of the underlying structure of the ^{70}Ga nucleus, which can then be used to test the most contemporary theoretical models that predict nuclear behavior.

PARITY MEASUREMENTS IN THE ^{70}GA NUCLEUS

The odd-odd ^{70}Ga nucleus was studied at high spin after being produced at Florida State University using the ^{62}Ni(^{14}C, αpn) fusion-evaporation reaction at a beam energy of 50 MeV. The resulting γ rays were detected in coincidence using an array of Compton-suppressed Ge detectors consisting of three Clover detectors and seven single-crystal detectors. The linear polarizations of eight γ-ray transitions in ^{70}Ga were measured by comparing their scattering yields within a Clover detector in the parallel and perpendicular directions relative to the beam axis, under the requirement that at least one other γ ray in ^{70}Ga was recorded by a single-crystal detector in the array. As a result of these measurements, the parities of six states were confirmed and those of two other states were established for the first time based on a comparison of the experimental polarizations with the predicted ones determined from known spin assignments. The resulting level spectrum of ^{70}Ga shows both similarities and differences with those of its neighboring odd-odd Ga isotopes, as well as that predicted from previous shell-model calculations.

Board 14

MARY AGNES CRANLEY

Faculty Mentor:
Suren Ambegaokar
Department of Botany and Microbiology, Program in Neuroscience

The gene heme oxygenase-1 (HO-1) has the potential to be a key factor in the therapeutic treatments for viral infections such as HIV, Hepatitus C, and Ebola. The genome editing tool CRISPR/Cas9N is a revolutionary technology that we are employing to study if HO-1 can prevent infections of other viruses such as Vesicular Stomatitis Virus. This work will create a new tool that may help to lead to new medicines that can treat viral infections.

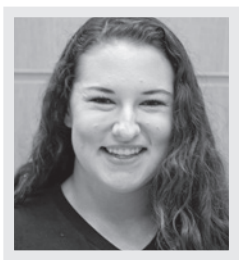
CAS9 NICKASE AND KNOCKING OUT GENE EXPRESSION OF HEME OXYGENASE-1 IN VERO CELLS

Heme Oxygenase-1 (HO-1) is a gene which is widely studied for its antiviral properties. Studies have shown that HO-1 is an anti-inflammatory and cytoprotective enzyme in response to several types of cellular injury such as oxidative stress, UV radiation, or heavy metal exposure. Expression of HO-1 is increased in individuals with neurodegenerative diseases such as Alzheimer's, and pharmacological induction of HO-1 results in reduced pathogenesis caused by HIV-1, in addition to other viruses. Vero cells, derived from Green Monkey kidney cells, are standard cell lines use in virological assays, including for the study of vesicular stomatitis virus (VSV). We hypothesize that HO-1 is protective against VSV infection in Vero cells, and that eliminating gene expression of HO-1 (or “knocking out” HO-1) will result in increased rates of VSV infection. To create this HO-1 knock-out in Vero cells, we are using the latest advancement in genome editing – the CRISPR/Cas9 Nickase system. The project will not only allow us to test if HO-1 can mitigate VSV infection, but will also make available to the scientific community a novel reagent to further investigate antiviral properties of HO-1, which may lead to therapeutic methods for treating viral infections.

Board 15

MADDIE MEYER
SAMANTHA FEDOUSH
ANA BORISH

Faculty Mentor: Chris Wolverton
Department of Botany and Microbiology



When a plant is rotated on its side, starch filled packets in root tip cells fall to the bottom of the cell, starting a process that results in the plant's growth back downward. Mutant plants without starch in these packets still grow downward if rotated sideways, but unlike normal plants, don't respond at different rates when stimulated at different angles, which suggests the mutants use a different signaling mechanism to reorient themselves. We are sending wild type and mutant plants to space to measure their rates of root reorientation when stimulated by different amounts of gravity in centrifuges, while also running ground experiments as a control group for comparison. By analyzing root growth response rates, we will determine whether the mutants' gravity response system is linked or separate from the plastid sedimenting mechanism, how much this second system contributes to overall gravity response in plants, and the threshold amount of gravity mutant plants must have in order to grow downward.

COLLECTING GROUND CONTROL DATA FOR A STUDY OF PLANT GRAVITY PERCEPTION ON THE ISS

Plants are sensitive to environmental cues like light direction and quality, touch, and gravity. They use these cues as inputs to direct their growth, allowing them to maximize their uptake of the energy, water, and mineral ions needed for growth and reproduction. Gravity is the only cue that is persistent in both magnitude and direction throughout the plant's life, profoundly influencing the plant body throughout its lifecycle. Plants perceive gravity in part through the sedimentation of starch-filled plastids found in gravity sensing cells. Upon displacement from a vertical orientation, primary roots respond to gravity at a rate that varies depending on the angle of inclination of the root cap. More recently, we have shown that roots that lack starch-filled plastids show reduced gravitropism and rates of differential growth that do not depend on the angle of inclination. These results suggest an alternate mechanism of gravity perception not involving plastid sedimentation. We are planning to characterize this alternate mechanism by applying fractional g treatments to wild type (Col-0) and starchless (*pgm-1*) genotypes of *Arabidopsis thaliana* using centrifugation in the EMCS facility aboard the ISS.

In preparation for the flight fractional g experiments, we have carried out a number of ground control experiments that mirror the flight experiment protocol as closely as possible. Experiments will be initiated on orbit by hydrating seeds attached to a membrane, which is mounted atop blotter paper containing growth media, all of which is inside hardware known as a Seed Cassette. Growing seedlings on flight membranes, we found that roots elongate and respond to gravity at a slightly lower rate than on traditional agar media. To better control for these differences and the entire growth regime experienced by the seedlings, we designed and 3D-printed Seed Cassette holders. These cassette holders enhance the ability to record time-lapse images of growth under identical lighting and stimulation protocols as what the seedlings will experience in the EMCS on orbit. We will present data on gravitropism following phototropic reorientation for both wild-type and *pgm-1* mutants, which will help in the interpretation of experimental data from flight.

Board 16

DIANYI LI

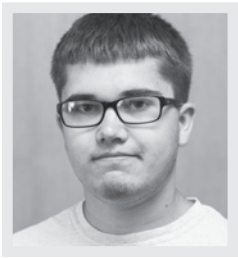
Faculty Mentor:
Nathan Amador Rowley
Department of Geology and Geography

I'm studying how Greenland Blocking Index(GBI) correlated with the climate factors such as temperature, solar radiation, and wind speed and direction in west central Greenland area, the Jakobshavn Ablation Region (JAR). By processing these two types of data set through Matlab, it reveals a positive relationship between GBI and climate variables. Then it can be assumed that the phase of Greenland Blocking Index is related to the high or low melt year and influence the lake melt in west central Greenland.

PRODUCTION AND ROUTING OF SURFACE MELTWATER ON THE GREENLAND ICE SHEET ABLATION ZONE

The melting period, June, July and August (JJA), along the west-central Greenland ablation zone represents a period of maximum melt lake occurrence. Greenland Blocking Index (GBI) are expected to be able to influence this melt occurrence. When GBI is in a very high positive phase, it can be perceived that the melt lake area comes into an anomaly high melt years. This study combines automatic weather station data acquired from the Greenland Climate Network, and synoptic-scale atmospheric, Greenland Blocking Index (GBI), to assess how the atmospheric indices influence the local climate variables and influence circulation patterns further on total melt lake area in the Jakobshavn Ablation Region (JAR). In this work, five stations (Crawford Point 1, Swiss Camp, JAR1, JAR2, and JAR3) in the Jakobshavn Ablation Region (JAR) are picked up for temperature, wind speed and direction, solar radiation and other atmospheric data. By plotting June, July and August (JJA) average temperature with JJA GBI, results of four stations reveal positive correlations between the atmospheric indices and local climate variable.

Board 17



KYLE DAVIS

Faculty Mentor: Dustin Reichard
Department of Zoology

I am studying the House sparrow (*Passer domesticus*) to see if they change in size based off where they are located in the United States. House sparrows were introduced to the United States in the 1700s. Since their introduction, House sparrows have spread across North America. I am looking to see if any size changes have occurred to the House sparrow during the 400 years that they have been in North America.

SIZE CHANGE IN AN OLD WORLD SPARROW

Evolution is typically seen as a process that takes millions of years to take place. Most studies on evolution use native species, or fossils, which have been in their environment for millions of years. Although we know that changes can be seen after millions of years in native species, we don't know when we could begin to see these changes taking place. Invasive species are destructive to the environment, and are typically seen as a pest. Although they are a pest, invasive species can be used to determine how long it takes for a species to adapt to a new environment. Often, we know the date and the location that the species was released, which can be used to determine how much time is needed for the introduced species to become different from their ancestral populations. While we know evolution happens over a long period of time, species such as the House sparrow (*Passer domesticus*) can be important in understanding how much time is needed to see changes in an organism. The House sparrow was introduced to North America about 400 years ago. Since its introduction in New York City, the House sparrow has slowly expanded its range and can now be found across North America. Due to the varying climates and habitats found in North America, we hypothesize that the House sparrow has begun to change in size and that these changes will be noticeable in their tarsometatarsus and bill lengths.


PINK

Board 18

DELANIE BAKER

Faculty Mentor: Matthew Anderson
Department of Microbiology, The Ohio State University; Biomedical Sciences Graduate Program, The Ohio State University; Department of Microbial Infection and Immunity, The Ohio State University Medical Center

Candida albicans is a yeast that normally exists in and on our bodies, but can causes yeast infections, as well as life-threatening deep-tissue infections. *C. albicans* uses an abnormal sexual cycle, called parasex, that makes identification of genes involved in disease-causing traits difficult. Our team is working to adapt a gene-identifying method that has never been used in a parasexual species to identify genes involved in drug resistance. Identification of these genes could lead to new drug targets in the future. In addition, the adaptation of this method will allow other researchers to easily identify genes linked to disease-causing traits in other parasexual species.

QUANTITATIVE TRAIT LOCI (QTL) MAPPING IN A PARASEXUAL SPECIES

Candida species are the most clinically relevant fungal pathogens, with *C. albicans* being the most prevalent. The standard frontline treatment for *Candida* is the azole class antifungal drug fluconazole. Resistance to fluconazole has increased since its introduction into the clinic. Although characteristic mutations are known to contribute to fluconazole resistance in *C. albicans*, ~33% of resistant isolates do not encode these genetic signatures of resistance. A lack of unbiased genotype-phenotype analysis methods exist for *C. albicans* due to a lack of meiosis, making identifying the mechanism of resistance in these isolates challenging. Quantitative trait loci (QTL) mapping is a method that uses meiosis to identify genetic loci contributing to a phenotype. Here, we describe an approach utilizing the alternative parasexual cycle of *C. albicans* to perform QTL mapping of a strain encoding an unknown mechanism of fluconazole resistance. This methodology will provide an unbiased method for identification of loci involved in virulence traits in any parasexually replicating species.y.

Board 19

CINDY HUYNH
MOLLIE MARSHALL

THEORY-TO-PRACTICE GRANT

Faculty Mentor: Kira Bailey
Department of Neuroscience and Psychology

We are studying the neurobehavioral and developmental effects of methamphetamine (MA) on infants. More specifically, we are focusing on how maternal MA abuse, which is often used among depressed mothers, affects infant mental health, temperament, and development. If a mother's history of substance abuse and/or mental health do negatively impact the infant, then it is necessary to develop and implement early intervention methods in order to protect those exposed infants.

A LOOK INTO THE EFFECTS OF PRENATAL SUBSTANCE USE EXPOSURE ON DEVELOPING INFANTS

Substance use is one of many risk factors that contribute to their infant's development, along with maternal depression, parental psychopathology, and the external environment. Women of childbearing age in the United States and New Zealand are among the increasing number of people who abuse methamphetamines (MA). Mothers who abuse MA are often also depressed, which is related to poor parenting behaviors and linked to changes in infant social behavior and temperament, a biologically based set of behavioral tendencies that influence how the infant will approach, respond to, and interact with the social world. Research has shown parental depression negatively impacts cognitive, motor, emotional, and social development. The current study further examines how a mother's history of substance abuse and/or psychopathology may impact infant health, temperament, and development. The study analyzes questionnaires and assessments from 234 mother-infant pairs in the NZ Infant Development, Environment, and Lifestyle Study. Of this sample, 106 mothers reported MA use during pregnancy and 115 denied MA use during pregnancy. Their substance use was compared with maternal report questionnaires — Brief Symptom Inventory, Beck Depression Inventory, and Infant Behavior Questionnaire — which measured maternal psychopathology, depression, and infant temperament. In addition, the results of the NICU Network Neurobehavioral Scale, Bayley Scales of Infant Development, and Strange Situation assessments were compared to standardized scales to determine infant behavior and attachment. The results from the maternal questionnaires were compared to the infant assessments to ascertain the effects of maternal substance abuse and/or psychopathology on infant mental health. The study points to the importance of early intervention and enhancing protective factors in multi-risk families.

Board 20

DEREK SHANK

Faculty Mentor: Timothy Beers
Department of Physics, University of Notre Dame

Stars have physical properties, such as temperature, which can be observed through data collected by large-scale astronomical surveys. The Cannon is a program which takes the collected stellar data and performs a series of tests to determine a star's properties. In future work stellar properties can be determined at a rate far faster with The Cannon compared to individually analyzing each star.

UTILIZING THE CANNON TO PREDICT STELLAR PARAMETERS

The Cannon is a data driven analysis tool designed to predict stellar parameters based on a transfer of "stellar labels" from external datasets to large-scale spectral catalogues. The prediction of stellar parameters such as metallicity ([Fe/H]), effective temperature (Teff), carbon abundance ratios ([C/Fe]), and surface gravity (log g) will enable users to focus their attention on interesting stars which meet their criteria. Synthetic normalized spectra were used as the reference set to properly calibrate The Cannon for the test sets. In future work The Cannon will be applied to stellar spectra collected by the Sloan Digital Sky Survey (SDSS), the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), and others. Comparison of the suggested stellar parameters from The Cannon with alternative approaches, such as the non-SEGUE Stellar Parameter Pipeline (n-SSPP) will greatly reduce the time required to obtain confident estimates.

Board 21

PEYTON HARDESTY

Faculty Mentor: Dave Noble
Head Apiarist at Stratford Ecological Center

As a beekeeping apprentice, I have learned healthy hive management methods that are drawn from observing the honey bee's instinctive behavior and natural processes. As the honey bee population declines, the necessity of spreading awareness to the public grows in pertinence, for our agricultural system will suffer from the plight of the honey bees. My acquired knowledge, interest, and skill as an apiary apprentice has readied me for educating others and thus, being an effective agent in the effort to save the honey bees.

APPRENTICING AN APIARIST AT STRATFORD ECOLOGICAL CENTER

Since November of 2006 when Colony Collapse Disorder (CCD) was first identified, the honey bee (*Apis mellifera*) has warranted an increase of concern and attention. As a result of factors, including stressful beekeeping methods at the industrial scale, chemical pollutants, and numerous diseases/infections, the honey bee population has been dramatically declining. I have apprenticed with a beekeeper, Dave Noble, at Stratford Ecological Center, who applies a healthy and sustainable system to his apiary, which consists of roughly fifty hives. Through hive management practices such as routine checks for mites and disease, queen marking, frame adjustment and honey extraction, I have been exposed to the inconceivable complexity that is the beehive. From their sophisticated communication via pheromones and movement to their dynamic life cycle that is interdependent to plants, the honey bees continue to enthrall me. Through this experience, I have acquired an abundance of knowledge, while having fostered a deep respect for the honey bee. As a result, I am capable of educating others about the superorganisms' excellence and necessity — an imperative step toward saving the honey bees.




Board 22

FRANCESCA SOCKI

Faculty Mentor: Shauna L. Price
Department of Integrative Research Center at the
Field Museum of Natural History in Chicago

My goal is to see how ecology affects the evolution of adaptive forms and to better understand trait evolution. To do this, I am studying the differences in head shape of the soldier castes across a specific genus of ant, commonly known as turtle ants. We want to see why there is such extreme variation in head shape occurring even though all soldiers are performing the same task of blocking the colony's nest entrances. Analyzing the anatomy of these heads from a 3D perspective may help us to define better characters to classify the types of head shapes we see in this genus.

THREE-DIMENSIONAL MODELING AND MORPHOMETRIC ANALYSIS OF THE ELABORATE SOLDIER HEAD IN TURTLE ANTS (*CEPHALOTES*)

Ants are ideal organisms to study evolutionary patterns due to their species richness, ecological significance, and morphological diversity. Ants are eusocial insects and therefore have specialized members of their colonies called castes that carry out different tasks. Soldiers are a caste that have the sole purpose of defending the colony. The diverse genus *Cephalotes*, also known as turtle ants, is a primary example of extreme morphological adaptation of the caste system. Many species of turtle ant soldiers have evolved heads that they physically use to block the entrances into their colonies. There are a variety of soldier head shapes that have been defined, with four types classified so far. For this study we wanted to quantify the variation in shape of soldier heads across *Cephalotes*, with the ultimate goal of understanding how soldier head shape evolves in *Cephalotes*. We used over 50 specimens of both soldiers and workers from the collections at the Field Museum of Natural History and scanned them using micro computed tomography (microCT) at the University of Chicago PaleoCT facility. Each specimen's scans were then processed, cleaned and reconstructed into a three dimensional model using several programs. The head was separated from the model, and excess body parts that could potentially cause error, such as antenna, were removed from the head. Morphometric analysis was then performed on all soldier heads to assess shape variation. This was performed by placing a thousand points over the entire surface of each ant head, both with three-dimensional and two-dimensional samples. We then measured the difference in the location of the points across our samples through principal component analysis (PCA) to quantify head shape. From here we will use our morphological data and turtle ant phylogeny to investigate trait evolution.

Board 23

GRETCHEN WEAVER

Faculty Mentor: Ivy Samuels
Louis Stokes VA Medical Center, Cleveland Clinic
Cole Eye Institute

I studied the effects of diabetic retinopathy in a mouse model. The protein GLUT1 stimulates more oxidative stress in the retina and leads to more damage of the eye's tissue. After examining a wildtype and mutant mouse type for a gene that accelerates the disease, we found there was no significant difference in the progression in the early stages of diabetic retinopathy.

DETERMINATION OF EARLY BIOCHEMICAL MARKERS IN THE PROGRESSION OF DIABETIC RETINOPATHY USING AN AKITA MOUSE MODEL

Diabetic retinopathy is the progressive loss of retinal function due to an excess amount of blood glucose in the body. This excess glucose in the blood can block the tiny vessels that nourish the retina; to compensate the eye undergoes angiogenesis, or the formation of new blood vessels. These new blood vessels, however, are weak and leaky and break more easily, resulting in further progression of diabetic retinopathy. Prior studies have shown that several proteins may play an early mechanistic role in diabetic retinopathy, including GLUT1 (glucose transporter 1 protein) and GFAP (glial fibrillary acidic protein). Oxidative stress, or the increase of reactive oxidative species, has also been shown to be involved with the progression of diabetic retinopathy.

A mouse model was utilized to simulate Type I diabetes. Akita mice are a strain of mice with a spontaneous mutation in the *insulin 2* gene. This mutation leads to an improper folding of the insulin protein causing toxicity, and eventual destruction, of the beta cells in the pancreas. The Akita strain of mice are therefore a good model for the progression of diabetic retinopathy due to Type 1 diabetes.

In order to determine early changes between the Akita wildtype and Akita mutant mouse, mice were sacrificed at one month of age. Eyes were then fresh frozen, cryosectioned onto slides, and then stained for dihydroethidium, or DHE, a biochemical marker for reactive oxidative species and oxidative stress. Another set of eyes were then fresh frozen, paraformaldehyde fixed, cryosectioned onto slides, and then double-stained for the expression of GLUT1 and GFAP. These slides were then imaged under a fluorescent microscope. Upon examination of the results, it was determined there was no significant between the wildtype and mutant Akita mice.

OWU is host to two Research Experience for Undergraduates (REU) Programs. REU Programs are competitively funded by the National Science Foundation and provide the opportunity for students and faculty to engage in cutting-edge research. Robert Haring-Kaye is the director of the REU hosted by the Physics/Astronomy and Mathematics/Computer Science Departments, and Christian Fink is the director of the REU hosted by the David O. Robbins Program in Neuroscience.

REU hosted by the Departments of Physics/Astronmomy and Mathematics/Computer Science

The main objective of our REU program is to give undergraduates interested in the mathematical and physical sciences experience with computational techniques as applied to cutting-edge research problems. Each summer, approximately seven students from colleges and universities distributed around the country visit the OWU campus to study research problems under the guidance of OWU faculty members in order to learn about computational methods (numerical, symbolic, and graphical) and how those methods can be used to solve a wide class of problems. Students, most for the first time, are exposed to an intensive, ten-week research experience that gives them an accurate representation of the nature of scientific research and also, through workshops and presentations by faculty and other students in the program, shows them how many techniques can make headway on diverse problems across several scientific disciplines. Students also receive guidance on careers in science, ethical conduct in research, preparation for graduate school, and tips for giving effective scientific presentations.

Robert Haring-Kaye
Director of the Physics/Astronomy Mathematics/Computer Science NSF-REU

REU hosted by the David O. Robbins Program in Neuroscience

Ohio Wesleyan collaborates with three other institutions (Earlham College, Kenyon College, and the College of Wooster) to host a multi-site Neuroscience REU program. Sixteen students and eight faculty meet every two weeks at one of the colleges, where they share and receive feedback on their latest research results. They also learn experimental techniques from faculty at the host institution, so that over the course of the summer students are exposed to the breadth of scientific inquiry within neuroscience. Students also learn about various career possibilities from faculty, and they spend one day traveling to The Ohio State University and the Battelle Research Institute. At the end of the summer, everyone gathers for a final symposium to share their research findings.

Christian Fink
Department of Physics and Astronomy

Board 24

JOSEPH EMERSON
OHIO WESLEYAN UNIVERSITY

MOMI AFELIN
ASHLAND UNIVERSITY

Faculty Mentor: Christian Fink
Department of Physics and Astronomy

Some patients suffering from epilepsy have to resort to surgery for treatment, in which a part of the brain is removed, sometimes resulting in detrimental side effects. In order to explore the feasibility of less destructive surgical techniques, we constructed a computer model to investigate how seizures that originate in small localized areas in the brain are dependent on the brain's physical structure for propagation to the rest of the brain. Using simulations produced by this model as a guide, we developed ranking algorithms based only on the connections between brain regions that tell us how proficient each brain region is at propagating the seizure. The development of these algorithms serves as an important step to identifying specific connections that can be severed to completely prevent the propagation of the seizure, while preserving the structure of the brain as much as possible.

COMPUTATIONAL MODELING OF SEIZURE PROPAGATION

Some epilepsy patients with focal onset must undergo resective surgeries, which involve removal of the brain region containing the seizure focus. It may be possible to achieve the same level of treatment by instead severing only a small number of connections from the ictogenic (i.e., seizure-producing) area. To understand how seizure propagation might hinge on the connectivity of the brain, this study attempts to identify the most influential nodes in a brain network, guided only by the network connectivity. Due to experimental limitations, there is no available data on directionality for the human connectome. Since seizure propagation depends on how the nodes are connected and in what direction the connections are oriented, we used the macaque connectome as our network template, which does contain data on directionality. Using a generic computational model describing seizure dynamics, we constructed a model macaque network capable of undergoing simulated seizures. By initiating seizures in a "seed" node, we were able to observe the extent to which the seizure propagated throughout the network. We used the extent of propagation to categorize the nodes as influential or non-influential seizers. This acted as our ground truth to compare against a number of predictive algorithms. Our simulation results showed that the distribution of influential seizers was consistent with real-world clinical data, indicating that ictogenesis may depend largely on network structure. Furthermore, our predictive algorithm demonstrated that the influential seizers could be distinguished fairly accurately using only information provided by the network connectivity. This lays the foundation for future work that will investigate how our algorithm can be used to determine which connections can be severed to prevent seizure propagation.

Board 25

SYDNEY QUINN

Faculty Mentor: Suren Ambegaokar
Department of Botany and Microbiology, Program in Neuroscience

We are interested in genes that are important for the brain to respond to injury, cellular damage, or physiological stress. We are using a powerhouse organism in genetics, the fruit fly (*Drosophila melanogaster*), to identify genes that respond uniquely in the brain when the flies undergo physiological stress, such as exposure to high heat. This project may allow us to learn which genes may be helpful to stimulate in order to restore health to damaged or diseased brains, such as in Alzheimer disease or stroke

EFFECTS OF PHYSIOLOGICAL STRESS ON HNRNP K GENE EXPRESSION IN *DROSOPHILA* BRAIN

Neurons, unlike most other cells in the body, do not divide or replicate and so most neurons are not replaced by new neurons if they are injured and/or die. Thus, it is likely that neurons use different mechanisms for survival than other non-neuronal cell types when a neuron is injured in order to promote cell viability. GSK-3β is an enzymatic regulator of cell metabolism and cell survival in nearly all eukaryotic cell types. We hypothesize that one alternate way neurons mitigate harmful effects is by regulating GSK-3β activity differentially than is found in other cell types. We have previously shown that changes in expression of the gene, hnRNP K, alter GSK-3β activity in the brains of fruit flies (*Drosophila*). We hypothesized that physiological insults would lead to changes in hnRNP K signaling in the brain that would then modulate GSK-3β signaling. To test this hypothesis, we used heat shock as a physiological stress and analyzed gene expression at various time points in brain and non-brain tissues for comparison. Our results show that acute heat shock causes variable gene expression of hnRNP K in the brain, but not does result in any substantial change in hnRNP K expression in non-brain tissue. In addition, there are robust changes in GSK-3β expression in the brain that are different to changes seen in non-brain tissue. These results, while preliminary, support our hypothesis that neuronal tissue responds to cellular stress differently than other tissue types, and that modulation of GSK-3β and hnRNP K expression may be key in this differential effect.

Board 26

BRIANNA HARBIN

NORTHERN KENTUCKY UNIVERSITY

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

The strong nuclear force, one of the four fundamental forces of nature and responsible for holding 99.9% of the visible matter in the universe together in atomic nuclei, has yet to be fully understood. One way to gain knowledge about this force is to test contemporary theoretical models that predict fundamental properties of nuclei based on our current understanding of the strong force. In this study, we are providing a test case for contemporary theoretical predictions by measuring fundamental structure properties of a particular germanium isotope (^{70}Ge). Comparing these measured properties to the predicted ones provides further evidence for the reliability of the models and could lead to modifications of them that might contribute to an improved understanding of the strong force.

PARITY MEASUREMENTS IN ^{70}GE

Previous studies of the ^{70}Ge nucleus have left open questions about its decay spectrum, in particular the spins and parities of the high-spin states. These uncertainties have hindered the comparison between the observed high-spin level scheme and the predicted one based on recent shell-model calculations. The goal of this work was thus to measure the parity of as many high-spin states in ^{70}Ge as possible. High-spin states in 70Ge were produced from the ^{62}Ni(^{14}C, $\alpha 2n$) reaction performed at Florida State University with a beam energy of 50 MeV. The resulting γ decays were measured in coincidence using a Compton-suppressed Ge array consisting of three Clover detectors and seven single-crystal detectors. These data were sorted such that the parallel and perpendicular Compton-scattering yields in a Clover detector (relative to the beam direction) were measured under the condition that another γ decay in ^{70}Ge was also detected in coincidence. By comparing the parallel and perpendicular scattering intensities, the linear polarizations of eight transitions in ^{70}Ge were measured, leading to the confirmation of eight parity assignments. Although the high-spin transitions were too weak to measure their polarizations, the measurements for the low-spin transitions show good agreement with the polarizations measured previously as well as with theoretical predictions based on previous angular distribution measurements.

ROBERT WARTON

UNIVERSITY OF FINDLAY

Faculty Mentor: Sean McCulloch
Department of Mathematics and Computer Science

Eurorails is a modern turn based strategy board game where the players build railroad track by drawing with crayon on the board to connect mileposts, and then traverse it with their trains to pick up and drop off goods. We have created a digital representation of the game board as a network, as well as built the structure around it to enforce the rules of the game. Using this, we have created an agent to efficiently evaluate various possible plans for playing the game and select the best strategy.

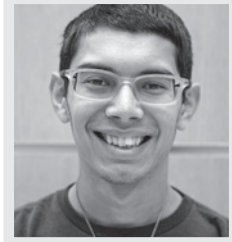
DESIGNING AN INTELLIGENT AGENT FOR EURORAILS

Classic board games such as chess have been the main focus of Artificial Intelligence work, while comparatively little has been done for modern board games. These games differ in many ways from classic board games, specifically in that they often have more options in a given turn, giving them a high branching factor making traditional A.I. techniques infeasible. We have created an intelligent agent with these limitations in mind for Eurorails, a popular modern rail-building board game, in order to create an algorithm to efficiently come up with a viable strategy. The game consists of nodes that represent either a city or terrain type, which we represent as the vertices of a graph, and train track the player builds that connect these nodes, represented by connections on our graph. We created a system to enforce the rules of the game on top of this graph that represents the game board. Additionally, we came up with a heuristic to look at possible strategies in laying out our rail and analyze them to choose the best one. We also created a heuristic to intelligently prune out options that are likely to be bad in order to reduce the number of possible strategies we have to consider. This resulted in an efficient algorithm for finding a good strategy in a reasonable amount of time.

BRIAN REYES

UNIVERSITY OF PUERTO RICO

Faculty Mentor: Scott Linder
Department of Mathematics and Computer Science



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

Researchers commonly wish to estimate the strength and nature of the relationship between two variables. For example, we might believe that the duration of a monkey's life (X) is closely related to the amount of plaque in its aorta (Y). Rather than waiting for, say, 20 monkeys to die, researchers sometimes economize the amount of time needed to conduct an experiment and instead observe the first 20 deaths from an original sample of, say, 200 monkeys. This is an example of Type II censoring, and occurs in many settings. The act of censoring renders the sampling distributions of statistics associated with commonly used inferential methods mathematically intractable, and they need to be approximated typically using simulation. In this work, we consider inference for the population correlation coefficient Rho between two variables *X* and *Y* in a Bivariate Normal model. The Fisher *Z*-transformation of the ordinary sample correlation coefficient, *r*, is typically used to provide an approximate sampling distribution that can be exploited to construct a confidence interval for Rho. This method is known to work well for full samples as small as $n = 8$ or 10. Here we consider the case when the data are in a concomitant order and subjected to Type II censoring, so we observe only those cases associated with the smallest p of *n* values of *X*. We demonstrate that censoring impacts the quality of inference using Fisher's Z-transformation: Confidence intervals have far from nominal confidence levels when censoring is heavy or the population correlation coefficient is far from zero. We also demonstrate that this degradation is caused by a systematic error of the Normal distribution in estimating the percentiles of the sampling distribution described above. Using simulation, we document these errors and then construct a regression model that a researcher could use to correct these percentile estimates from experimental conditions *n*, *p* and *r*. As a result, the researcher can then construct confidence intervals for *r* with confidence intervals much closer to nominal.

ERICKA BEYRENT

UNIVERSITY OF SCRANTON

Faculty Mentor: Suren Ambegaokar
Department of Botany and Microbiology, Program in Neuroscience

In patients with Alzheimer's disease, the protein tau is overly abundant, is modified differently than normal tau proteins, and forms clumps with other tau proteins. This project may uncover a gene that could play a role in controlling the levels of tau, which may help in understanding or even mitigating Alzheimer disease.

EFFECTS OF MIR-7 ON TAU EXPRESSION

Abnormal expression of the microtubule-associated protein tau (MAPT) has been shown to play a role in neurodegenerative disorders. In individuals with neurodegenerative disorders, including Alzheimer's disease and Parkinson's disease, aggregates of MAPT have commonly been identified. Previous research in our lab has shown that co-expression of tau with microRNA-7 (miR-7) in transgenic fruit flies (*Drosophila*) results in repression of tau protein expression. Thus, we wished to investigate if there was a direct interaction between miR-7 and MAPT. Human embryonic kidney (HEK) cells were transfected with plasmids containing MAPT, and co-transfected with plasmids containing miR-7 or a control microRNA. All MAPT plasmids were tagged with a red-fluorescent protein (mCherry or DsRed), and all miR-7 or control microRNA plasmids co-expressed a green fluorescent protein (GFP). This allowed evaluation of MAPT expression by measuring levels of red fluorescence in cells double-labeled for red and green fluorescence. MAPT expression was reduced by 29% when co-expressed with miR-7, as compared to control microRNA co-expression or MAPT expression without co-transfection, indicating a possible direct interaction between miR-7 and MAPT transcript. MAPT plasmids were then mutated via site-directed mutagenesis at 1 of the predicted 8 binding sites for miR-7. Expression of the mutated tau plasmid was reduced by 27%-43% when co-expressed with miR-7, compared to expression of the mutated tau plasmid alone. These results suggest that miR-7 specifically binds to the MAPT transcript to inhibit expression, but not at the binding site we tested. Our future studies will focus on testing the remaining 7 binding sites for miR-7 on the MAPT transcript.

KELLY FULLIN

ASHLAND UNIVERSITY

Faculty Mentor: Christian Fink
Department of Physics and Astronomy

We are creating and testing algorithms to quickly identify the most influential members of networks. Our algorithms would be applicable to any form of network, from models of disease spread to followers on social media. We are focusing on directed networks, such as Twitter, where connections may not be reciprocated. By identifying the most influential members, or nodes, we can determine how best to increase or prevent spread of ideas or disease throughout a network.

IDENTIFYING INFLUENTIAL NODES IN WEIGHTED, DIRECTED NETWORKS

In fields such as epidemiology, networks are used to visualize and predict spreading patterns of diseases. By identifying key members (or "nodes") of this network we might in principle stop an epidemic spread of disease by vaccinating the most influential nodes. While much research has been done in undirected networks, relatively little has focused on directed networks. We are interested in finding a way to efficiently measure the influence of individual nodes in weighted and directed networks. We ran computer simulations using the SIR (susceptible, infected, recovered) model of disease spread in which a single "seed" node was initially infected. We then defined this node's influence by counting the total number of nodes it infected. We have succeeded in developing an algorithm that initial tests indicate accurately determines the influence of each node up to 10 times faster than actually running the brute force simulations.

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 the senior year. The program is open to students who have attained cumulative grade point averages of 3.5 in their majors after fall semester of the junior year, as well as overall grade point averages of 3.0 or the support of their academic major departments, and have successfully petitioned the Ohio Wesleyan Academic Policy Committee.

Student Name	Supervising Professor	Title
Caroline Anderson	Ramon Carreno	Parasite Communities in the Declining Population of the Muskrat (Ondatra Zibethicus) in Ohio
Alyssa Clark	Sarah Bunnell	Longitudinal Study on Writing About Past Personal Experiences
Megan Deeter	Ramon Carreno	Examination of Pinworm (Order Oxyorida) Parasitic niche Specialization and Diversity Within the Digestive Tracts of Millipedes (Order Diplopoda)
Michael Mora-Brenes	Eva Paris-Huesca	Spanish Contemporary Noir Fictions: A Look at its Origins, Characteristics and Socio-Political Implications
Jocelyne Muñoz	Eva Paris-Huesca	Understanding the Health Issues Amongst Latina Women in the United States
Diana Muzina	Ted Cohen	Doing Gender in Women's Greek Lettered Organizations

HERE ARE SOME OF THE THINGS PAST SSRP PARTICIPANTS ARE DOING NOW.

Meg Deeter
Starting graduate school in Entomology at University of Arizona.

Austin Minnick
Working as a patient care assistant for Lake Health in preparation for applying to Physician Assistant school at Cleveland State University.

Shannon Schlater
Until July 2017, in Hawaii for a predator removal project (invasive rats) in order to increase Elepaio (a flycatcher) population sizes. In August, starting graduate school at University of Nebraska Kearney working on a raptor project concerning the effects of human activity (cars, agriculture, fragmentation, etc.) on aspects of raptor ecology.

Ifa Abduljelil
Taking the MCAT and applying to Medical School. Working in a medically-oriented job at a Central Ohio hospital.

Erin Boedicker
Starting graduate school in Analytical Chemistry at Colorado State.

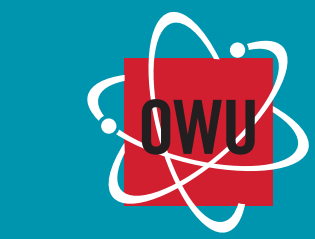
Yuxiao Tan
Starting graduate school in Microbiology at University of Colorado Boulder.

Campus and Off-Campus Researchers

NSF-REU Researchers

Special Thanks

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



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