September 24, 2018

Patricia Belt Conrades

Summer Science Research Symposium

Ohio Wesleyan University

KHÁNH LÊ, OWU '16

Ph.D. Candidate in Mathematics at Temple University

"My summer research experience at OWU taught me important skills in research such as formulating questions, breaking up complex problems into simple pieces, and double-checking my own work. Most importantly, the research experience showed me the joy of discovery, and strengthened my resolve to pursue a Ph.D. Since then, the lessons that I learned from OWU research experience has always helped me getting through difficulties and has made my time at graduate school a wonderful experience."

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-sixth 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 24, 2018, at noon

Opening remarks by President Rock Jones followed by student poster presentations

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 19 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 9 OWU students who performed research off campus at other universities or in other countries. There is no doubt that the results presented here today are exciting and novel. However, equally exciting is the opportunity for you to speak with each of these young scientists about what discoveries they have made.

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

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

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. An additional funding grant for students came from the National Science Foundation-Research Experience for Undergraduates (NSF-REU) program for the Departments of Physics/Astronomy and Mathematics/Computer Science. In the following pages, students listed were part of the SSRP unless otherwise noted.

Board 1

EUGENE KRAMSKOI
OHIO WESLEYAN UNIVERSITY

MIRA JACOBS
SYRACUSE UNIVERSITY

Faculty Mentor: Sean McCulloch
Department of Mathematics and Computer Science

We've managed to teach computers to play games such as Chess, Checkers, and even Go, but certain categories of more abstract board games have been largely ignored. Specifically, there has been very little work done on European-style board games. The purpose of our research is to create a program that will intelligently play the board game Pandemic, and in the process learn about the algorithms and other challenges that making an algorithm to play this game introduces. Since Pandemic is a completely different style of game when compared to games such as Chess, this work will help us get a more thorough general understanding of artificial intelligence.

ARTIFICIAL INTELLIGENCE FOR THE BOARD GAME PANDEMIC

Pandemic is a co-operative board game where two to four players are given the task of curing all four of the diseases that plague the forty-eight interconnected cities on the board's map. The players must work together to travel from city to city and prevent the diseases from spreading while simultaneously researching a cure. There has been little research done on intelligent agents for European-style board games such as Pandemic. The goal of this research is to create a program that will intelligently play the board game Pandemic, and in the process learn about the algorithms and other challenges that an automatic player program for this type of game introduces. We have created a program that enforces the rules of the game and allows a combination of both human and computer players to play. Our computer player works by executing the most effective plan out of a list of generated possible abstract plans, where a plan is an abstract notion of a combination of smaller moves. To evaluate the effectiveness of plans, the program calculates how each plan would influence the time until loss and the time until win. These two metrics are approximations of the amount of turns that it would take the players to win or lose respectively. Time until loss is calculated by simulating the game so as to count how many turns it would take to lose if the players didn't do any actions. Time until win is calculated by using probability to get the average time it would take execute a plan that would cure all the diseases.

Board 2

AMANDA C. JEWELL
OHIO WESLEYAN UNIVERSITY

BROOKE K. KIMSEY-MILLER
INDIANA UNIVERSITY

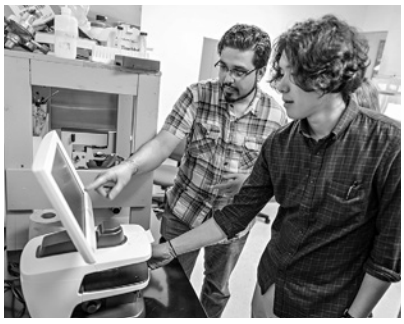
Faculty Mentor: Robert O. Harmon
Department of Physics and Astronomy

Sunspots are regions of strong magnetic fields on the sun's surface that have been cooled and thereby darkened by the interactions between these fields and the gas that makes up the star. Sunspots never cover more than about 2% of the sun's surface, but sunspots on other stars, which are called starspots, can cover a much larger fraction of the surface. LO Pegasi is a star whose starspots are large enough that their impact on its brightness is easily detectable through a telescope as LO Pegasi rotates every 10.153 hours. We used a CCD (specialized digital) camera to take photos through our telescope that we then analyzed with a standard astronomical technique called aperture photometry in order to measure its variations in brightness over time. We collected data over three nights in July (7-9) 2018 and then entered the data into a program that uses the star's brightness variations to create a model of LO Pegasi's surface and starspots.

STARSPOTS ON LO PEGASI

Star spots are cooler, darker regions on the surface of a star in which strong magnetic field's cause the suppression of convection, which is the primary method of energy transfer in the outer layers of sun – like stars. LO Pegasi is a young, sunlike star whose starspots can cover a significant fraction of the stars surface. Comparatively, the sons of sunspots are much smaller and can only cover about 2% of its service: LO Pegasi is much faster rotation (10.153 hours versus the suns ~30 days) induces a much stronger magnetic field, which in turn causes the spots to be much larger than on the Sun. As the spots come in or out of view on the side of the star facing earth, they can have significant impact on measure brightness. We acquired CCD camera images over three nights 7–9 July 2018, through standard astronomical B, V, R, and I filters. The brightness variations of LO Pegasi were determined using differential aperture photometry by comparing it to a known, stable reference star. These brightness variations were then input into a light curve inversion program to produce maps of starspot distribution across the surface. These plots and models are presented and compared to previous years' findings to determine how the surface of LO Pegasi has changed over time.






Board 3

STEFANI SCHMOCKER

Faculty Mentor: Laurel Anderson
Department of Botany and Microbiology

Garlic mustard (*Alliaria petiolata*) is an invasive herb that has rapidly spread across the eastern North American continent in the last 150 years. Current research suggests that garlic mustard produces chemicals that can hinder the growth of native plant species, impacting plant populations beneath forest canopies. Currently, it is speculated that decomposing tree matter may aid in the growth of garlic mustard by releasing beneficial nutrients to the soil. In this study, we measured individual garlic mustard plants' largest leaf and proximity to decaying woody matter and statistically compared these measurements to see whether the decomposing matter influences the growth of garlic mustard. We collected soil samples near the decaying tree matter and analyzed the soil for chemicals that can aid in this plant's development. Additionally, as part of a long-term garlic mustard population data collection, garlic mustard individuals and other understory species were counted in sections of forested land.

EFFECTS OF GARLIC MUSTARD ON THE OHIO DECIDUOUS FOREST

Alliaria petiolata is an invasive understory plant introduced to the North American continent during the mid-1800's from eastern Europe. Since then, this species has infiltrated forest ecosystems across the eastern United States and Canada. Currently, it is not known whether certain soil conditions benefit the growth of garlic mustard. We conducted a study of garlic mustard association with coarse woody debris and surveyed permanent vegetation plots at the Kraus Nature Preserve in Delaware, Ohio. For the coarse woody debris study, 100 first-year *A. petiolata* individuals were sampled along a fifty meter transect in an area with decaying logs (coarse woody debris). Each plant's largest leaf length and proximity to the nearest decaying woody debris were measured. Additionally, soil samples were collected within 30 cm of coarse woody debris and in sites with no coarse woody debris within a meter of the soil sample. Soil analyses revealed that soil in the vicinity of the decaying woody debris had significantly greater moisture and organic matter than the debris-absent soils, however there was no significant difference in soil phosphorus levels between the two soil types. Despite the difference in soil conditions, no correlation was found between rosette leaf size and proximity of the rosette to coarse woody debris. As such, more research may be necessary to establish if decaying woody matter impacts A. petiolata growth. In the permanent plot study, individual plant species were counted within 2x2 meter squares in the summer of 2018 and compared to data collected in previous years. Examination of the *A. petiolata* population counts in each plot revealed a pattern of invasion characterized by a rapid climb at the onset and a steep drop-off in later years. Furthermore, there was found to be a significant positive correlation between the *A. petiolata* count and the Shannon-Weaver diversity index of the plot, implying that garlic mustard invasion may be associated with higher biodiversity.

Board 4

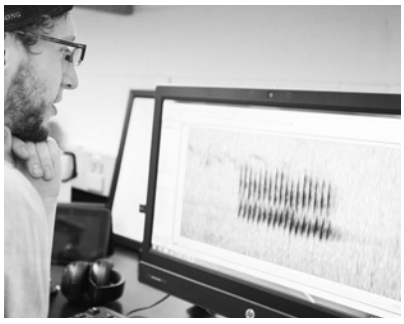
LEXI LEASE
MICKEY RICE
MALIA WALKER

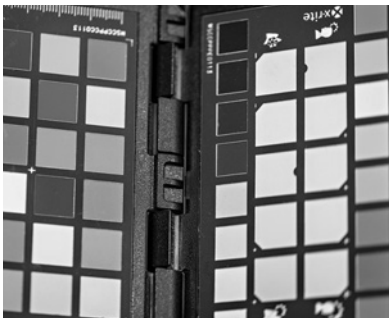
Faculty Mentor: Kira Bailey
Department of Psychology, Neuroscience Program

With the widespread use of video games it is important to understand the effects that they might have on our abilities to regulate, coordinate, and sequence thoughts and actions, skills collectively known as cognitive control. This study examines how brief video game exposure affects cognitive control by measuring electrical activity from the brain using an electroencephalogram (EEG). Participants in this study played 20 minutes of either a first-person shooter video game or a strategy video game, and then completed tasks that assess cognitive control while temporary changes of their brain's electrical activity were recorded from the scalp. Based on past research, we hypothesized that brief exposure to a strategy video game will improve cognitive control as indexed by accuracy, response time, and differences in recorded brain activity; first-person shooter video games, in contrast, may have no effect or may actually be detrimental to the use of cognitive control.

THE EFFECTS OF VIDEO GAME EXPOSURE ON COGNITIVE CONTROL

This study examines the effects of brief video game exposure on cognitive control using event-related potentials (ERPs). Cognitive control is examined under the context of the Dual Mechanisms of Control theory, which proposes that cognitive control is made of two types of control, reactive and proactive. Individuals alternate between these two modes based on current task demands (Braver, 2012). Based on previous research (West & Bailey, 2012), the frontal slow wave and conflict SP ERP components index proactive and reactive control, respectively. Participants played 20 minutes of either a first-person shooter or strategy video game and then completed the counting Stroop and Flanker tasks while ERPs were recorded. Past research has shown that proactive control is negatively correlated with higher levels of video game experience, but reactive control shows little difference (Bailey, West & Anderson, 2010). We hypothesize that brief exposure to a strategy video game will improve the use of proactive cognitive control as indexed by accuracy, response time, and amplitude of the frontal slow wave. Participants exposed to the strategy game will show higher accuracy in blocks with more incongruent/incompatible trials and display more prominent slow wave activity, indicating a greater use of proactive control. First-person shooter video games, in contrast, may have no effect or may be detrimental to the use of proactive control.





Board 5

MICHAEL HEESCHEN

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

Relatively little is known about the gallium-70 (^{70}Ga) atomic nucleus, consisting of 31 protons and 39 neutrons, partly because of the difficulty to produce it abundantly in the laboratory. However, it is important to study such nuclei since contemporary theoretical models are becoming increasingly accurate in predicting the fundamental properties of nuclei as heavy as gallium. To provide a good test case for these models, we need to be able to measure and understand as many of these fundamental properties as possible, especially for systems that have not been studied much before. Thus the goal of this research was to measure quantities such as the energy and angular momentum (related to how fast the nucleus rotates) of ^{70}Ga after it is produced in a nuclear reaction, so these properties can eventually be used to test the predictions of relevant theoretical models.

LEVEL SCHEME AND SPIN ASSIGNMENTS IN ^{70}GA

Currently, little is known about high-spin states in odd-odd ^{70}Ga. However, a 9+ state was identified at 2887 keV, which could be the start of a high-spin rotational band based on a proton and neutron occupation of the $g_{9/2}$ orbital. The goal of this work was to search for evidence of this structure. The ^{70}Ga nuclei were produced following the ^{62}Ni(^{14}C, αpn) reaction at 50 MeV performed at Florida State University. The γ decays were detected in coincidence with a Compton-suppressed Ge array consisting of three Clover detectors and seven single-crystal detectors. Spins were assigned from measured directional correlation of oriented nuclei (DCO) ratios and their comparison with theoretical values. A new high-spin band based on the 9^+ state was observed and appears to show rotational character. The behavior of the moment-of-inertia of this band is similar to that of other odd-odd nuclei in this mass region, but the signature-splitting pattern indicates an irregular phase reversal at high spin.

Board 6

REBECCA PORTER
KATIE VONDEREMBSE
COLIN HAWES

Faculty Mentor: Amy Downing
Department of Zoology

The United States spreads approximately 10 million tons of road de-icing salt per year to keep roads safe. However, when this salt is washed away, it can enter bodies of water where it can potentially harm animals and water quality. We are examining the effect of salt concentration on the abundance and variety of certain microscopic organisms by replicating the conditions of a local pond in a small, controlled environment. Evidence that road salt can have toxic effects on these animals may encourage the use of a more environmentally friendly alternative to salt.

THE GLOBAL SALT EXPERIMENT

Runoff from human activities can have harmful effects on freshwater ecosystems. Road salt and agricultural pollutants can enter bodies of water, potentially disrupting their stability. To explore the effects of salt and nutrient runoff on freshwater ecosystems, we participated in a 20 site study across the northern USA, Canada, and Europe. In this study, we exposed communities of zooplankton to concentrations of sodium chloride (NaCl) ranging from 5 to 1,500 mg Cl-/L. The experiment consisted of fifty-three 325 liter mesocosms located adjacent to the lower pond at Ohio Wesleyan University's Kraus Nature Preserve in Delaware, OH. Each mesocosm was filled with the adjacent pond water and its natural microbial, phytoplankton, and zooplankton communities, excluding large macroinvertebrates and fish. All tanks were treated with a gradient of NaCl. In 21 of the tanks, we added 50% more nutrients than in the natural pond to examine how the systems would react to NaCl with additional nitrogen and phosphorus, common nutrients in agricultural runoff. Over 6 weeks, we took bi-weekly samples from the mesocosms for zooplankton and phytoplankton (algae) abundance data and collected water chemistry and quality parameters. Preliminary data analysis suggests that high salt concentrations are toxic for all species of zooplankton. Of the three main groups of zooplankton found, rotifers had the highest tolerance, followed by copepods. Cladocerans, such as *Daphnia* and *Scapholeberis*, had the lowest tolerance. Our data indicate that tanks with additional nutrients had higher abundances of zooplankton up to a certain threshold (~1,000 mg Cl-/L), due to an increase in algae, the main food source for zooplankton. As zooplankton decreased at high concentrations of salt, algae increased, which is characteristic of unhealthy freshwater ecosystems. These findings suggest that if the use of road salt continues, changes should be implemented in order to conserve freshwater ecosystems.

Board 7

CAILYNNE ANGELO

Faculty Mentors: Elizabeth Schultz and Dustin Reichard
Department of Zoology

In any situation, organisms must work with limited resources and allocate a limited energy supply in order to adapt to their current surroundings. One important task that requires significant energy is maintaining immune function; however, when energy is more necessary elsewhere, less is available to support the immune system. We tested these energy trade-offs in nesting House Wrens (*Troglodytes aedon*) by creating a stressful situation for the parents and then measuring their immune response to *e. coli*, measuring the levels of stress hormones in their blood, and counting the number of white blood cells. This provides an idea of how the environment and other factors limit immune function and reproductive success in the wild.

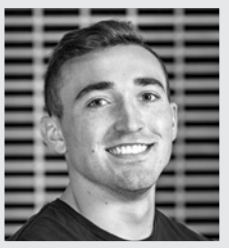
IMMUNE FUNCTION AND ACUTE STRESS RESPONSE DURING SIMULATED PREDATOR PRESENTATIONS IN *TROGLODYTES AEDON*

Because energy is limited, animals must allocate it differently in order to adapt to varying circumstances. Levels of stress hormones such as corticosterone are documented as being inversely related to degree of immune function during periods of chronic or long-term stress, while acute or short-term stresses are predicted to elevate immune function. In this study, the trade-off between corticosterone and immune function was tested in female House Wrens (*Troglodytes aedon*) with 2-6 day old nestlings. Experimental trials included a simulated predation period using a model snake, a common nest predator, which was placed on top of a nest box. We then recorded behaviors such as flyovers, attacks, alarm calls, and amount of time spent within either 1m or 5m of the nest, for five minutes while the snake was presented. Once complete, the snake was removed and blood was collected within three minutes following the female's capture, ranging from 0-20 minutes post-trial. From the blood, we measured bacterial killing ability using *E. coli* and conducted white blood cell counts using whole blood, and measured levels of corticosterone using plasma. Trials were then compared against a control group of females whose nests were not subjected to simulated predator presentation. Females in the control group were at the same nest-stage as the experimental group, and the blood sampling techniques remained the same as in the experimental trials. Results will provide insight into the environmental and physiological limitations of immunity and reproductive success in free-living animals.

Board 8

JACKSON DRUCKENBROAD
RAMSHA SHAH
NOLAN NORMAN

Faculty Mentor:
Allen J. Pistner
Department of Chemistry



We are creating an organic molecule called dipyrrin that has the potential to be used in wide ranging applications from cancer treatments to the functioning of fuel cells. Photodynamic therapy, a particular cancer treatment, has been proven to be safer and more targeted than standard chemotherapy. Fuel cells have the ability to supply power with the only by-product being water, which makes the fuel cells more environmentally friendly than using standard gasoline. By using two different routes to synthesize this molecule, we are hoping to find a better and more effective route in forming dipyrrin.

REDOX ACTIVE LIGAND SCAFFOLD FOR THE ACTIVATION OF OXYGEN

A redox active ligand scaffold, the dipyrrin, was synthesized with the interest in activating oxygen. The synthesis of the scaffold was approached using two different pathways. The original pathway using a published procedure starting with a Negishi-type coupling followed by a condensation with an aryl aldehyde. The second pathway is a new approach, constructing the scaffold from the top down beginning with synthesis of the dipyrromethane followed by subsequent bromination and Suzuki cross-coupling steps. The new pathway provides the opportunity to use more stable and commercially available reagents to potentially improve the overall efficiency of the synthesis. The dipyrrin scaffold was synthesized with a differing aryl group (phenyl or pentafluorophenyl) and was analyzed using UV-vis spectroscopy and electrochemical techniques displaying strong long-wave absorption and redox activity. Attempts in the formation of metal complexes are currently underway.

Board 9

JOE BRUSH

Faculty Mentors:
Dustin Reichard and
Elizabeth Schultz
Department of Zoology

Aggressive behavior resulting from social interactions causes specific changes in the levels of circulating hormones in animals. This summer we worked to further define the relationship between aggressive behavior and testosterone and corticosterone levels in males of two North American songbird species. By playing recordings of rival males, we elicited a territorial response from each bird, recorded their behavior, then caught them and collected a blood sample. We found that these species respond differently to the simulated intruder, and the blood will be analyzed later to determine the relationship between aggression and these hormones.

SOCIAL MODULATION OF TESTOSTERONE AND CORTICOSTERONE IN TWO SPECIES OF NORTH AMERICAN WREN

In songbirds, aggressive behavior plays an important role in the social interactions between members of a population. These behaviors are necessary for establishing territories and securing mates. Circulating hormones such as testosterone regulate these behaviors throughout the reproductive cycle, rising during the breeding season. Other hormones are also associated with aggressive behavior and stress but do not fluctuate seasonally, such as corticosterone. The "Challenge Hypothesis" postulates that during specific social interactions, levels of these hormones rise to their physiological limits. To further investigate the relationship between these specific hormones and aggressive behavior, we studied male house (*Troglodytes aedon*) and Carolina (*Thryothorus ludovicianus*) wrens. We conducted simulated territorial intrusions (STIs) using the playback of a conspecific male within the territory of an established wren, provoking a behavioral response that was quantified. We then caught the bird and took a blood sample within three minutes. A preliminary behavioral analysis suggests that house wrens sing more and are more active in response to an intruder. The plasma will be analyzed using hormone assays to determine the level of circulating hormone in each bird.

Board 10

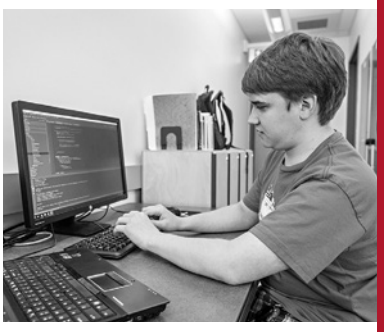
LANDRY COWLES
JIN JUN
MADDIE MEYER

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

Studying cells *in vitro* (in a dish) allows us to observe cell growth, cell-to-cell interactions, and test the effects of various chemicals on these cells more easily than could be done in a whole organism (*in vivo*). Studying neurons *in vitro* would make it easier to study neuronal development and diseases like Alzheimer disease, but neurons are difficult to grow and keep alive. As an alternative, some tumor cells are easier to maintain *in vitro*, and under certain conditions, can be differentiated, or changed, into neuron-like cells which look and function much like neurons. This summer, the Ambegaokar lab has experimented with which conditions best grow neuron-like cells from these tumor cells.

OPTIMIZATION OF DIFFERENTIATION OF SH-SY5Y CELLS AS A MODEL SYSTEM FOR NEURONS

Like all cells, neurons are derived from “stem cells” or “precursor cells,” but the factors that induce neuronal differentiation are still largely unknown, and growing and maintaining neurons *in vitro* is difficult. SH-SY5Y cells are human brain-tumor derived but behave like “neuronal progenitor cells,” which grow and divide under normal conditions , but have potential to differentiate into neuron-like cells, having axons, similar morphology to neurons, and the ability to carry electric potentials cell to cell. However, several different protocols on differentiation have been published, each with varying levels of success. Our goal was to systematically test the various components from published protocols and derive a treatment protocol that resulted in robust differentiation as efficiently as possible. In previous studies, retinoic acid (RA) has been shown to trigger the inception of “neurogenesis” in SH-SY5Y cells, while other supplements are then later added to maintain neuronal growth, including potassium chloride, vitamin B-12, brain-derived neurotrophic factor (BDNF), Ara-C, db-cAMP, and the proprietary supplement, B-27. Our results show that e a 3-day treatment with RA and BDNF followed by a 7-day treatment with potassium chloride, B-27, and db-cAMP were the parameters that yielded the most neuron-like cells, as observed through light microscopy. Future directions include confirming the expression of neuronal genes via quantitative PCR (qPCR) and immuno-fluorescence microscopy. With an optimized differentiation protocol, we will be able to use SH-SY5Y cells to study human neuronal development and neurodegenerative disorders such as Alzheimer disease.



Board 11

AIDAN SHUMAKER

Faculty Mentor: Laurel Anderson
Department of Botany and Microbiology

In Dr. Anderson's lab we are studying greenhouse gas emissions underneath invasive Amur Honeysuckle and native Spicebush shrub species. We want to know whether or not soils under honeysuckle emit more greenhouse gasses than soils under native shrubs, possibly affecting local and global warming. This may occur because invasive honeysuckle has early leaf production and keeps its leaves longer than most native plants, and has higher leaf nitrogen, possibly stimulating longer root activity and greater decomposition by microbes, which could increase gas emissions. Our research will contribute to a better understanding of the impacts of invasive species on a local or even global scales

EFFECTS OF AMUR HONEYSUCKLE ON SOIL CO_2 EMISSIONS

Lonicera maackii is an invasive woody species found in Ohio and throughout the deciduous forests of eastern United States, taking over habitats of native shrub species such as *Lindera benzoin*. *L. maackii* has unique traits compared to deciduous forest natives, showing earlier leaf-out and later leaf senescence, higher leaf nitrogen levels, and faster leaf decomposition. As a result, *L. maackii* may alter soil conditions through its extended root activity and impacts on microbial decomposition, possibly impacting soil CO_2 emissions. As soil microorganisms metabolize organic matter, they release greenhouse gases like CO_2 through respiration, which can impact global climate change. Previous research has shown that microbial respiration under an invasive shrub of the mediterranean coastal dunes was significantly altered compared to the native species of this ecosystem, indicating a possible total increase of greenhouse gas emissions. However, the effects of *L. maackii* on soil respiration have been understudied, with no considerations towards the possible effects of this shrub on local forest greenhouse emissions. To monitor CO_2 emissions underneath *L. maackii*, a LI-COR LI-6400 was used to measure CO_2 efflux using PVC soil collars embedded into the soil. These measurements were compared with soil efflux data collected from beneath native *L. benzoin* as well as patches of open soil at least 1 m away from the canopy dripline of any shrub. Soil respiration measurements collected in June 2018 showed no significant difference in CO_2 emissions among the three soil conditions. However, since the measurements have only been taken in the summer, the high productivity of both native and invasive plants during this season may explain these similarities. More measurements across all seasons will be collected later to assess if *L. maackii* impacts soil respiration at other times, particularly when this species experiences early leaf-out and late senescence and native plants are dormant.





TACTICAL TEAM TRAINERS
T3
SOCCER
1999
COMPETE·EXCEL

Board 12

LUCAS FARMER

Faculty Mentor: Timothy Hawthorne
Department of Sociology, University of Central Florida

Collecting high resolution imagery to update and replace satellite imagery of mapped islands. Interviews were conducted to bring context to our imagery by gathering real life knowledge and experience about the islands over time. From this data we intend to develop multiple types of deliverable (story maps, postcards, calendars, maps, prints of imagery) to be added into a large open data set available to the public and our community partners.

DRONE MAPPING AND SPATIAL STORYTELLING

Islands off the Coast of Belize are essential assets for the tourism industry within the Country of Belize. Through the use of DJI Phantom 4 drones we are able to capture high resolution imagery of Islands in order to provide a visual to help explain what exactly is changing on islands. By doing so, the imagery gathered during the data collection process will be used in place of outdated and low-resolution satellite imagery. With the imagery gathered we will use ESRI's Drone 2 Map to process data, creating large orthomosaics of individual islands. These orthomosaics will then be used while digitizing, using ArcMap, to look at several aspects of the islands, such as, island boundaries, structures, and vegetation. Another aspect of this research includes interviewing locals that either reside, work, or visit the islands. This connection enhances the understanding of what has and is changing with these islands. The imagery alone is cannot express the what has happened to these islands communities over long periods of time, as they are only a snapshot in time. Preliminary data points toward multiple different aspects of islands changing over time. As we have mapped and conducted interviews we can see multiple themes arise during our data collection and analysis. These themes include: the impact of the tourism industry, how island boundaries have changed over the years, the effects of mangrove loss, and information regarding different kinds of structures (seawalls, buildings, docks). This type of data set will provide much needed local knowledge explaining the impacts and adaptations to these island environments. All data will be open to the public to be used for the betterment of these island communities.

Board 13

EVA BLOCKSTEIN

Faculty Mentor: Brian Gratwicke[1] and Roberto Ibañez[2]
Smithsonian Conservation Biology Institute[1]
Panama Amphibian Rescue and Conservation Center[2]

Used Theory-to-Practice Grant to spend summer in Panama. Volunteered at Amphibian Rescue and Conservation Center through the Smithsonian Tropical Research Institute, learning about conservation of endangered frog species. Worked in center with captive breeding population of frogs extinct in the wild. Learned about daily care needed to keep these frogs alive and happy, and learned from lots of important scientists.

TPG- STUDYING CONSERVATION IN ENDANGERED PANAMANIAN FROGS

In 2004, the International Union for Conservation of Nature (IUCN) updated their Red List of Threatened Species to indicate that 32% of amphibians are threatened, and 21% of amphibians are Critically Endangered or Endangered. The Red List also indicated that 61% of recorded amphibian species are declining, 38.3% are stable, and only 0.69% are increasing. This decline can be attributed to many causes working in tandem, including human exploitation, habitat loss, global change, and a deadly fungus called *Batrachochytrium dendrobatidis* (Bd or Chytrid). Chytrid is known as a frog killing plague and is highly contagious, spreading through streams and water sources. It was first noticed in Panama in 1996, when scientists realized that the famous Panamanian Golden Frog (*Atelopus zeteki*) was declining, and since then Chytrid has been found across all of Panama, and the Golden Frog can no longer be seen in the wild.

In response to the threat against amphibians, the Smithsonian and other scientific communities decided to create an "ark" for the amphibians, and safeguard the most endangered species in Panama by creating captive breeding colonies. The scientists collected members of 9 of the most endangered species from Panama and moved them into the completely quarantined center in the hopes that one day they can be reintroduced to the wild.

Thanks to funding from OWU, I was able to spend my summer volunteering at the Amphibian Rescue Center in Panama and learning about the efforts to protect the frogs of Panama. I helped with the daily husbandry of the highly endangered frogs, learning about the care that is needed for these specific and sensitive species, and was able to observe and work with some of the leading scientists fighting every day to protect these frog species.

Board 14

DIEGO VENEGAS VARGAS

Faculty Mentor: Alfredo Galindo-Urribari
Department: Oak Ridge National Laboratory, Physics Division

Diego Venegas Vargas[1,2], Alan Salcedo Gomez[1,2], Alfredo Galindo-Uribarri[1,2]
[1]Department of Physics and Astronomy, University of Tennessee, Knoxville
[2]Physics Division, Oak Ridge National Laboratory

A neutrino is one of the many fundamental particles of nature that make up most of the visible matter in the universe. Neutrinos are often referred to as "ghost" particles given that they might be the most elusive particles of all since they can pass through solid objects. Neutrinos have a fascinating property which is known as an oscillation. This corresponds to the change in "flavor" of a neutrino as it travels through space. Today, three neutrino flavors are known (electron, muon and tau) which are part of the Standard Model of physics. The PROSPECT experiment will attempt to search for a new type of neutrino oscillation known as a sterile neutrino, which would invoke significant changes in the standard model along with our understanding of fundamental physics.

NEUTRINO PHYSICS WITH PROSPECT BACKGROUND CHARACTERIZATION AT THE HIGH FLUX ISOTOPE REACTOR (HFIR)

The Precision Reactor Oscillation and Spectrum Experiment (PROSPECT) is a neutrino experiment at short baselines that aims to search for the existence of sterile neutrinos and precisely measure the energy spectrum of antineutrinos emitted from the Oak Ridge National Laboratory's High Flux Isotope Reactor (HFIR). A complete characterization of background sources present throughout the course of the experiment is required to obtain a proper understanding of the reactor's response, as well as to investigate the variation of background during operation periods. The PROSPECT detector has been collecting data since March 16th of the present year. This study presents data obtained through measurements and simulations of the background sources at HFIR, along with preliminary results of the detector's performance. A brief overview of the detector's status and main physics goals are presented.

Board 15

MARGARET MICHICICH

Faculty Mentor: Satoshi Namekawa
Department of Reproductive Sciences at Cincinnati Children's Hospital Medical Center (CCHMC)

MBD3 is a protein in the NuRD complex which alters DNA packaging. A mutant mouse line with an *Mbd3* deletion in the male germline (cells involved in forming sperm) was created. Mutant testes and epididymides were extracted and dyed to locate the NuRD complex proteins in different cells. I characterized the wild type and mutant samples for three NuRD complex proteins and described their accumulation in the testes to try to understand the role of MBD3 in forming sperm.

INVESTIGATION OF MBD3 FUNCTION IN SPERMATOGENESIS

Epigenetic changes in the germline can affect fertility. The function of Methyl CpG Binding Domain Protein 3 (MBD3) was studied to elucidate how epigenetic machinery regulates germline development. MBD3 is part of the Nucleosome Remodeling and Deacetylase (NuRD) complex which remodels and deacetylates histones. To determine the role of MBD3 in mouse spermatogenesis, we conditionally deleted the *Mbd3* gene using Cre-LoxP-mediated recombination in germ cells. The Vasa-Cre ERT2 transgene with Cre-mediated recombination can be expressed in germ cells under the control of a germline-specific, tamoxifen sensitive, Vasa promoter. Chromosomal spreads of spermatocytes and tissue sections of testes and epididymides were examined. MBD3 localization was examined in the germ cells of *Mbd3*-cKO mice to confirm depletion. However, testes stainings showed apparent MBD3 signal. This may be explained by stem cells escaping the inducible deletion and repopulating the testes with *Mbd3* positive cells. Another possible explanation is that the MBD3 antibody used was non-specific, binding to other isoforms of MBD3 or other MBD containing proteins. The localization of CHD4 and MTA1, other NuRD components, were examined. The localization of CHD4 and MTA1 showed no difference between the mutants and controls. Additionally, prophase I of meiosis progressed normally and all expected cell types were present. Interestingly, mutant testes were significantly larger than the control. With regard to fertility, a cross between *Mbd3*-cKO and wild type mice did not transmit the deleted *Mbd3* allele to offspring, suggesting a link between MBD3 depletion and infertility. The difficulties with the model prevent definite conclusions from three biological replicates. However, it appears that there is normal meiosis progression in the *Mbd3*-cKO testes. The differences between the controls and mutants must be studied further.

Board 16

KYLE DAVIS

Faculty Mentors: Laura Tuhela-Reuning[1,2] and Dustin Reichard[2]
Departments of Botany and Microbiology[1] and Zoology[2]

Bacteria have been found that can degrade feathers. I am looking to see if they can be found in Costa Rica, a country in the Neotropics. If feather-degrading bacteria is found in Costa Rica then tests will be ran to see how quickly it degrade feathers compared to bacteria found in the United States.

FEATHER-DEGRADING BACTERIA IN A TROPICAL ENVIRONMENT

Bacteria can use a variety of pathways to gain the resources they need to survive and replicate. Bacteria have been found in chicken coops that degrade the Beta-keratin of feathers. Later, feather-degrading bacteria were found on free ranging, wild birds within the United States. Most research on feather-degrading bacteria has been conducted in temperate regions within the United States. Researchers have started to look for feather-degrading bacteria in areas such as Australia and Europe. Although more research is being conducted on feather-degrading bacteria, very little research has focused on the Neotropics. Our research aims to find and characterize feather-degrading bacteria found within Costa Rica, a country within the Neotropics. Bacteria were collected from feathers taken from the venter, back, and tail of birds captured in mist nets from June through July. Once collected, feathers were placed in Whirl-Pack Bags and stored in a refrigerator at the Monteverde Institute until mid-August. Feather samples were transported back to Ohio Wesleyan University where they could be tested for feather-degrading bacteria. Bacteria will be collected from the feathers with sterile saline and spread onto Tryptic Soy Agar. Bacteria will be incubated at 37°C for two days. After incubating, colonies will be counted and any possible feather-degrading bacteria will be identified by morphology. The possible feather-degrading bacteria will be streaked for isolation and feather-degrading tests will be conducted. Bacteria that are able to degrade feathers will be stored on CryoBeads and placed in our feather-degrading bacteria collection. Birds with feather-degrading bacteria will be compared to see if their life history influences the amount of feather-degrading bacteria found on them. How quickly the feather is degraded will be compared between samples found within Costa Rica and the United States.

Board 17

JACK HIBBARD

Faculty Mentor: Herbert L. DuPont
Department of Internal Medicine at McGovern Medical School

Clostridium difficile infection (CDI), which is caused by an overgrowth of *Clostridium difficile* bacteria in the gut, is the leading cause of death from diarrhea in the United States. It has been recently treated effectively by fecal microbiota transplantation (FMT), a process in which fecal material from a healthy donor is carefully prepared and transferred to the recipient's colon. The goal of this study was to identify if stool levels of two organic compounds abundant in the gut, known as calprotectin and indole, could be used to predict whether or not a CDI patient would respond well to FMT. High levels of calprotectin in patients were seen in treatment failures, while high levels of indole were associated with successful treatment and recovery.

PREDICATIVE VALUE OF FECAL INDOLE AND CALPROTECTIN IN SUCCESSFUL OUTCOME IN FECAL MICROBIOTA TRANSPLANTATION (FMT) FOR *CLOSTRIDIUM DIFFICILE* INFECTION (CDI)

Clostridium difficile infection (CDI) is the leading cause of death from diarrhea in the United States and has recently been shown to be effectively treated by fecal microbiota transplantation (FMT), a process which involves the transfer of fecal material from healthy donor to patient in an attempt to diversify the patient's microbiome and prevent recurring *Clostridium difficile* overpopulation. This study aimed to evaluate the predicative value of two prospective biomarkers, calprotectin and indole, in a patient's potential response to FMT. Elevated levels of calprotectin have been associated with high levels of inflammation brought on by cases such as inflammatory bowel disease and CDI and has been shown to decrease with FMT, while indole has been related to producing positive beneficial effects on the gut through various mechanisms. This study analyzed stool samples from several subjects both before and seven days after undergoing FMT. Fecal indole levels were measured by a colorimetric assay using published methods, and fecal calprotectin by ELISA. Results showed that under certain conditions, increased fecal calprotectin levels correlated with poor response while increased fecal indole levels were associated with successful outcome and lack of recurrence in patients with CDI after undergoing FMT.

Board 18

JOSEPH EMERSON

Faculty Mentor: George Popescu
Institute for Genomics, Biocomputing & Biotechnology, Mississippi State University

Different genes often share similar functions. It is useful to categorize genes in such a way that these similarities are made apparent. One way of doing so is to analyze protein sequences to determine structural and evolutionary relationships between genes. We examine the performance of a widely-used computational tool used for gene classification and implement this tool in an automated workflow, which is used to classify the genes of seven different plant species into functional groupings.

PERFORMANCE ANALYSIS OF A GENE FAMILY CLASSIFICATION METHOD FOR PLANT KINOME IDENTIFICATION

Gene families are defined by structural and evolutionary relationships and often display a common evolutionarily conserved function among family members. These qualities make this system of classification useful in many areas of functional and evolutionary genomics. Currently, plant gene family classification relies on the construction of hidden Markov models constructed from model organisms such as *Arabidopsis thaliana* or using curated datasets to search for gene homology. There is a lack of standardized methods for determining gene families which often leads to discrepancies in gene classification. We propose a new measure integrating homology identification, motif conservation, phylo-genomic, and integrated expression analyses to define gene families. The process requires minimal manual curation of datasets. An analysis of the MAP3K gene family from seven different plant species, five previously examined and two unexamined, was performed using this process. Results showed that our method outperformed other recent efforts for the identification of gene families in these species. Furthermore, the analysis provided new insights into the evolutionary development and function of the MAP3K gene family in the species examined.

Board 19

JACK MAUTER

Faculty Mentor: Mitchell Grayson
Department of Allergy and immunology, Nationwide Children's Hospital

HDM has been shown to protect mice from viral infections. Our lab wanted to confirm this was from an immune response to the HDM and not a difference in the epithelial cells (the first cells the virus would infect). We used HAE cells in vitro to isolate and control the condition of the cells and easily monitor viral spread and barrier function.

HOUSE DUST MITE EFFECT ON VIRAL REPLICATION IN HUMAN AIRWAY EPITHELIAL CELLS

Asthma is a chronic disease that affects over 200 million people around the world and has no cure. Increasing evidence has shown that early respiratory viral infection can lead to an increased risk of developing asthma. In a study of patients from the H1N1 pandemic of 2009, it was found that those with asthma had a lower mortality rate than those whithout. Our lab has shown that mice that receive house dust mite (HDM) intranasally before a normally lethal dose of respiratory virus (Sendai virus) survive the infection. This experiment aims to study the effect of HDM on viral replication in human airway epithelial cells (HAE) in vitro. The objective was to determine if HDM affects the epithelial binding and replication of respiratory virus. HAE cells were infected in vitro with SeV or respitory syncytial virus (RSV). Doing so isolates the exposed cells from any circulating immune cell interference in the viral replication. The strains of RSV and SeV used express a green fluorescent protein (GFP) and allow the viral spread to be monitored with a fluorescence microscope. The cells are given a dosage of 10µg HDM, which is left on the cells for four hours and then removed. The dose of HDM was optimized in a previous experiment conducted this summer. This treatment is given for four days and on day six the cells are infected with either 400 plaque forming units (pfu) of RSV or 5000 pfu of SeV. The viral spread is monitored for three days after the initial infection. The barrier resistance and tight junctions were also analyzed before and after the three days of infection. HDM does not have a significant effect on viral replication ($p>0.05$) between the level of fluorescent. However, barrier resistance does show a significant difference ($p<0.05$) between RSV and HDM-RSV. The data showed HDM-RSV had a lower barrier resistance than RSV alone. These preliminary results indicate that the epithelial cells are being effected by HDM, but not in a way that affected viral replication.

Board 20

SERENA GEORGE

DEPARTMENT OF ZOOLOGY, OHIO WESLEYAN UNIVERSITY
SARAH BRINK, COLLEGE OF THE HOLY CROSS, WORCESTER, MASSACHUSETTS, smbrin19@g.holycross.edu

Faculty Mentors: John Kioko
School for Field Studies Center for Wildlife Management Studies

Ticks are parasites that feed on other organisms' blood, and they can transfer diseases to humans and animals. We looked for ticks on roadkill vertebrates, which allowed many different types of animals to be examined without stressing out or harming live animals. The goal of this study is to better understand what kind of ticks are found in Northern Tanzania, what types of animals those ticks normally feed on, and which tick-borne diseases people and animals may be at risk for.

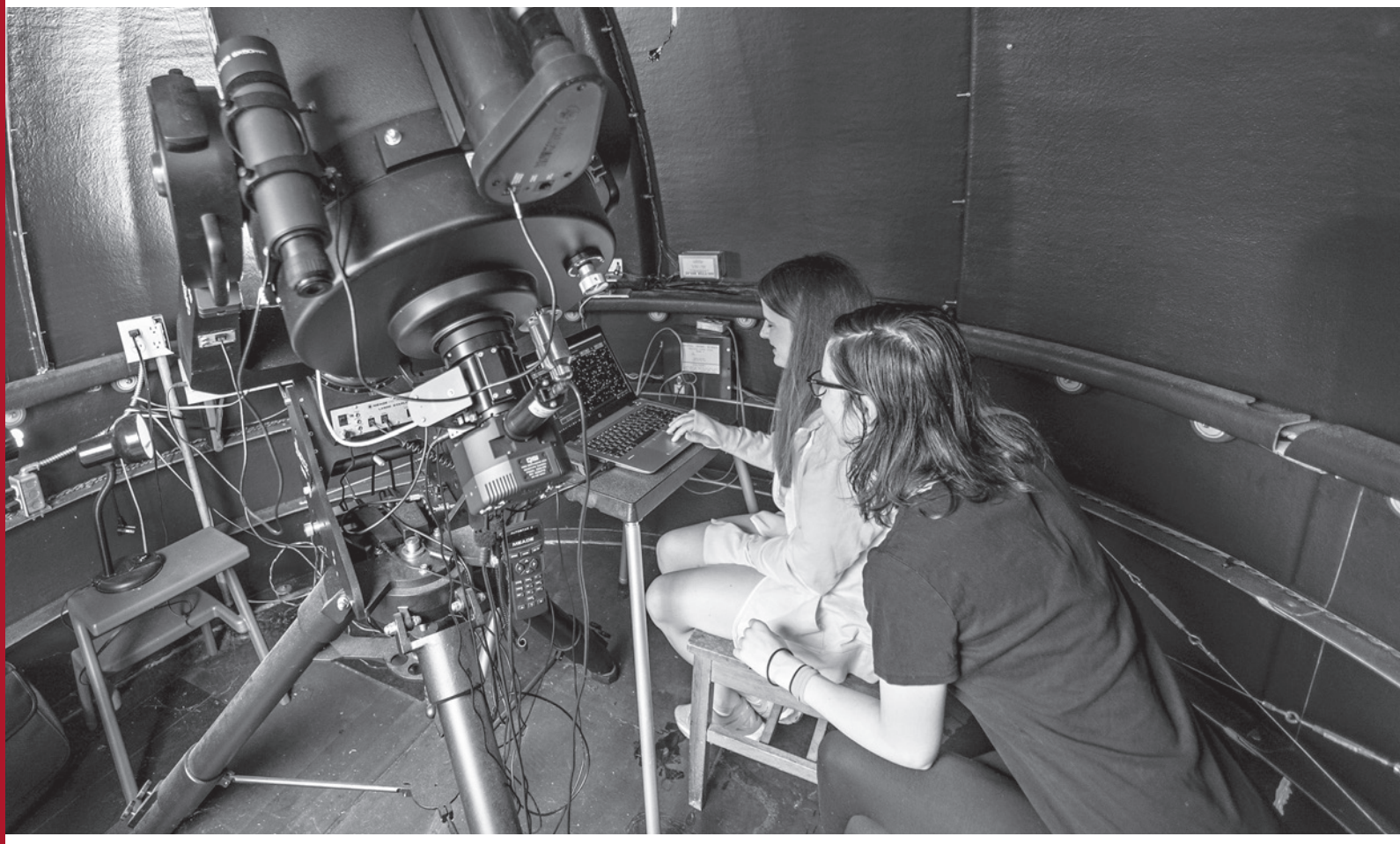
TICK ECTOPARASITES ON ROADKILL VERTEBRATES IN NORTHERN TANZANIA

Of all the arthropod ectoparasites, ticks transmit the widest range of both human and animal pathogens. To examine tick species prevalence and potential impacts, roadkill vertebrates were assessed for ticks along a 75km stretch of the Karatu-Makuyuni-Burunge road in the Tarangire-Manyara Ecosystem for ten days. In total, 164 ticks (9 species, 3 genera) were collected from 11 out of 49 (22.4%) inspected roadkill vertebrates. A significantly higher proportion of mammals (45%) had ticks than reptiles (25%) and birds (4%). Domestic animals (75%) more often had ticks than wild animals (12.2%). Medium-sized vertebrates (75%) and larger vertebrates (66.7%) were more likely to carry ticks than smaller vertebrates (7.9%). *Rhipicephalus* was the most abundant (n=129) genus, and *Rh. sanguineus* and *Rh. appendiculatus* were the most prevalent tick species (4 hosts). Plains zebra had the largest load (n=97) while dogs had the highest species richness (n=7). All tick species collected (*Amblyomma sp., Haemaphysalis sp., Rhipicephalus spp.*) have been known to feed on humans. Diseases that pose a large threat to both public and animal health, namely tick typhus, anaplasmosis, babesiosis, heartwater and East Coast Fever, were among the potential diseases the collected species could transmit. These results stress the importance of cautious, immediate and proper removal of roadkill. While long-term studies are needed and screening ticks for pathogens is recommended for future studies, this study demonstrated the potential roadkill ecology has for furthering the understanding of tick ecology and disease epidemiology.

The Research Experience for Undergraduates (REU) Program Hosted by the Physics/Astronomy and Math/Computer Science Departments, Funded by the National Science Foundation:

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 Math/CS Physics/Astronomy NSF-REU



Board 21

BOJANA IVANIC

UNIVERSITY OF TEXAS

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

Atomic nuclei in the so-called "Wild West" of the nuclear landscape are capable of possessing both strong and unusual deformations (departures from a spherical shape). Most arsenic (As) nuclei are known to have prolate shapes that resemble an American football. In contrast, the ^{74}As isotope has been proposed to have a completely asymmetric (triaxial) shape based on an irregular pattern of its energy differences as a function of angular momentum (related to how fast it rotates). However, this conclusion was based on uncertain angular momentum (spin) values, which this research sought to measure accurately. Our results confirm the existing spin assignments, supporting the interpretations of previous work.

CONFIRMATION OF IRREGULAR SIGNATURE SPLITTING IN ^{74}AS

Most odd-odd nuclei in the mass A ~ 70 region exhibit a very consistent alternating pattern in the energy differences between adjacent states (signature splitting) in their strongest positive-parity bands. In odd-odd ^{74}As, the pattern shows an irregular phase reversal at high spin, which has been attributed to the onset of an unpaired band crossing with an underlying triaxial deformation. However, this interpretation depends critically on the behavior of the signature-splitting pattern, which is based on uncertain spin assignments. The primary motivation for this study was thus to make firm spin assignments in the strongest positive-parity band of ^{74}As. High-spin states in ^{74}As were produced using the ^{14}C(^{62}Ni, pn) reaction with a beam energy of 50 MeV at Florida State University. γ-γ coincidences were measured using a Compton-suppressed Ge detector array comprised of three Clover detectors and seven single-crystal detectors. Measurements of directional correlation of oriented nuclei (DCO) ratios were used to confirm most of the spin assignments in the strongest positive-parity band, supporting the interpretations of previous work.

Board 22

AMELIA DOETSCH

WAYNE STATE UNIVERSITY

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

Arsenic-73 (^{73}As) belongs to a region of atomic nuclei known as the "Wild West." This name stems from the fact that these nuclei have structural properties that are not as predictable as their heavier neighbors. In particular, certain isotopes in the Wild West have exhibited evidence for strongly deformed shapes (resembling American footballs) based on a rather unique configuration of their constituent protons. The goal of this study was to search for the "fingerprint" of a similar structure in ^{73}As. Although none was found, this result can help inform contemporary theoretical models as to why some isotopes exhibit this structure while others do not.

THE SEARCH FOR $\pi f_{7/2}$ INTRUDER STATES IN ^{73}AS

Proton occupation of the $f_{7/2}$ orbital (the $\pi f_{7/2}$ configuration) in the mass A ~ 70 region is rare since it would require large prolate shape deformation ($\beta_2 \geq 0.4$). So far, there are only two known cases of such an occupation in this region (^{71}As and ^{67}Cu). The aim of this study was to search for evidence of $\pi f_{7/2}$ states in ^{73}As. High-spin states in ^{73}As were populated using the ^{14}C(^{62}Ni, *p2n*) reaction at 50 MeV performed at Florida State University. A Compton-suppressed Ge detector array made up of three Clover detectors and seven single-crystal detectors was used to record γ-γ coincidences. Directional correlation of oriented nuclei ratios (R_{DCO}) were used to assign spins. Coincidence data showed no evidence of a $f_{7/2}$ band structure. Furthermore, a state at 577 keV that was previously thought to have a spin of 7/2 (and which could be the head of a $\pi f_{7/2}$ band) was instead determined to have a spin of 5/2 based on R_{DCO} measurements. These results suggest that there is no $\pi f_{7/2}$ orbital occupation in ^{73}As.

CHACE COVINGTON

FRANCIS MARION UNIVERSITY

Faculty Mentor: Craig Jackson
Department of Mathematics and Computer Science

Ecological stability describes how an ecosystem, such as a freshwater plankton community, behaves after an environmental change. Measures of stability can be made using experimental data or by using theoretical community matrices that describe how individual species are related in the ecosystem. If there is a link between empirical and theoretical measures of stability, understanding that link will allow ecologists to better understand how outside forces, such as human actions, affect the long-term health of ecosystems. In our study we use computer simulations to determine mathematical relationships between several different measurements of ecological stability.

THEORETICAL NOTIONS OF ECOLOGICAL STABILITY AND THEIR RELATION TO TEMPORAL VARIABILITY

Ecological stability describes how populations of species in an ecosystem behave after a disturbance and can be measured by empirically and theoretically. Our experiment uses a first-order multivariate autoregressive model framework to explore the possible relationships between empirical and theoretical measures of ecological stability and the possible relationships between different theoretical measures of ecological stability. The empirical measures of stability included in this study are the average population coefficient of variation, the weighted average population coefficient of variation, and the community coefficient of variation. All theoretical measures of stability included are derived from a theoretical community matrix and include asymptotic resilience, initial resilience and reactivity, and intrinsic stochastic invariability. We find no evidence for any relationship between empirical and theoretical measures of ecological stability. This result is in agreement with previous experimental research by Downing, Jackson, and Plunket. However, we do observe clear relationships between different theoretical measures of ecological stability. We formalize these relationships with inequalities similar to those derived by Arnoldi et al. for continuous models.

CARINA DICHELLO

SALVE REGINA UNIVERSITY

Faculty Mentor: Craig Jackson
Department of Mathematics and Computer Science

There are a number of systems that strengthen or weaken the changes in global Earth surface temperatures that are expected to result from an increase in atmospheric carbon dioxide. These systems are called feedbacks. One important feedback system depends on the reflectivity of snow and ice. In my research I used a spatially resolved numerical climate model to analyze the local and non-local contribution of this individual feedback process to surface warming. An understanding of the mechanisms underlying climate feedback systems is important to scientists when trying to understand the spatial distribution of surface temperature in future global warming scenarios.

ANALYSIS OF CLIMATE FEEDBACKS

In the Earth climate system there are a number of important feedback systems. A feedback is a geophysical sub-system of the climate that acts to amplify or dampen the temperature change in response to forcing (for example, due to increased atmospheric carbon dioxide). One important feedback process is the ice albedo feedback. Ice albedo refers to the degree to which the sun's energy is reflected back into space by relatively reflective snow and ice. When the earth warms and the ice and snow melt, then there is less ice surface to reflect solar energy which leads to further warming. Ice albedo feedback is a positive feedback, meaning it amplifies the change in surface temperature that we would see if the feedback was not active.

In this research, a matrix-based approach to feedback analysis is developed and used to analyze the local and non-local contribution of ice albedo feedback to surface warming in fully generic forcing scenarios in the context of a spatially resolved numerical climate model developed by Dommenget and Floer. In particular, gain matrices are derived that encode the extent to which non-local changes in surface temperature are integrated by the feedback process to shape the global temperature anomaly when the model is run with the feedback activated. We observe that ice albedo feedback causes extratropical temperature anomalies to contribute positively to temperature changes in the tropics as expected. Interestingly, however, we see that tropical temperature anomalies contribute negatively to the temperature response in the extratropics. We show how such behavior can be explained in the context of a conceptual two box energy balance model where a local tropical temperature increase leads to an increased latitudinal temperature gradient and therefore cooler polar temperatures, resulting in more planetary snow/ice. We hypothesize that a similar explanation holds in the more complex spatially resolved model.

JAMES KONOSKE

POINT LOMA NAZARENE UNIVERSITY

Faculty Mentor: Scott Linder
Department of Mathematics and Computer Science

In social and natural science the goal is to be able to predict the population. In order to do that we take sample distributions that we suspect represent the population parameters. In this project we are able to better look into what a sampling distribution of correlation under type II censoring would be without having to solve for the parameter rho which is normally unknown and needs to be calculated. Thus we are able to estimate a population without having to make many time consuming calculations.

INFERENCE FOR SAMPLE CORRELATION WHEN DATA ARE SUBJECTED TO TYPE II CENSORING

In social and natural science, it is frequently the goal to estimate correlation between two quantitative variables. This requires knowing the margin of error, which in turn depends on knowing the sampling distribution of the sample correlation coefficient *(r)*. However, when bivariate data is subjected to type II censoring on one of the variates, this sampling distribution is unknown.

We approximate the sampling distribution of the absolute value of $|r|$ by the Beta distribution, with parameters that depend on experimental conditions — original sample size (n), number of actual observations (p), and actual population correlation (ρ). Specifically, for each combination of (n, p, ρ), we simulate values of $|r|$, then computed Method of Moments estimates of parameters of the Beta distribution fit to them. We construct a least-squares regression function relating these parameter estimates to n, p and ρ.

Hence, armed with these regression functions, a researcher would be able to estimate percentiles of the sampling distribution of $|r|$, given a sample obtained in a clinical setting (using the sample correlation, r, instead of unknown ρ). This, in turn, would allow the researcher to estimate $|\rho|$ via a confidence interval, even though the actual sampling distribution of $|r|$ is unknown.

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

Joe Emerson
Participated in a computational biology REU at Alabama State University and submitting a research paper with Dr. Fink to *Network Neuroscience*. This research stems directly from the research Emerson completed with Dr. Fink last summer.

Erika Shultz
Conducted summer research on the neurological mechanisms of drug addiction and abuse at the University of Buffalo's Jacobs School of Medicine and Biomedical Sciences.

Paige Haenig
Attending the University of Illinois College of Veterinary Medicine.

Derek Shank
Attending graduate school at Notre Dame for astrophysics.

Dianyi Li
Attending Duke University pursuing a Master of Environmental Management in the Nicholas School of the Environment.

Madeleine Sorrick
Worked at the Ohio State University Biochemistry Department.

Colleen Chernowsky
Attending graduate school at the University of Wisconsin-Madison for a Ph.D. in chemistry.

Ben Whitbourn
Continued the SSRP research project during the 2017-18 academic year and worked for OWU Admission.

Serena George
Traveled to Zimbabwe to work at a wildlife rehab center funded by an OWU Theory-to-Practice Grant.

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	Department	Supervising Professor	Title
Michael Barr	English	Martin Hipsky	The Intellect of Stephen Dedalus in James Joyce's: *A Portrait of the Artist as a Young Man* and *Ulysses*
Brett Bowersox	Economics	Julide Yazar	Cognitive Hierarchy Model and its Application to Collegiate Thinking
Chloe Dyer	MFL – Spanish	Juan Armando Rojas	Third Nation: Narratives of the U.S. – Mexico Border
Jacqueline Feliciano	HHK	Andrew Busch	The Analysis of Muscular Imbalances of a Division Three Female Field Hockey Program
Emily Howald	Environmental Studies	Ellen Arnold	Landscape History and Conservation Biology: A Restoration Case Study
Isaac Kochman	Math	Craig Jackson	Analytic Numbers Theory and the Riemann Hypothesis
Dianyi Li	Geography	Nathan Amador Rowley	A Relationship Between the Arctic Oscillation and a Cold Weather Outbreak in Southern East China
Alexandra Medina	Zoology	Ramon Carreno	Host-Specificity in nematodes parasitic in Cockroaches
Truong Ngoc Lan Nguyen	Math	Alan Zaring	Experiments in Programming Language Extension
Christopher Pessell	Geography	Nathan Amador Rowley	Modeling Lake Volume and Meltwater Production of a Supraglacial Lake in the Ablation Zone of Western Greenland
Derek Shank	Physics (Astrophysics)	Robert Harmon	Using Light-Curve Inversion to Model the Surface of a Star
Meaghan Teitelman	MFL – French	Ana Oancea	Visions of Versailles: An analysis of perceptions of the Château of Versailles through visual media
Meaghan Teitelman	SOAN	Ted Cohen	The Social Resume: Impression Management in College Women

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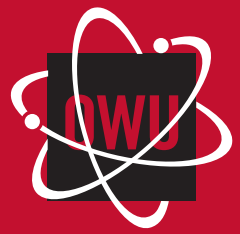

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