Patricia Belt Conrades

Summer Science Research Symposium

September 23, 2019

Ohio Wesleyan University

ERIN BOEDICKER , OWU '17

Chemistry major; SSRP 2015; Ph.D. candidate at Colorado State University

"The SSRP helped me decide on a career path by giving me a better understanding of scientific research and its associated expectations, which was instrumental in my decision to pursue graduate school. It also helped me cultivate problem solving and creative thinking skills that have been invaluable in my current work."

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-seventh 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

September 23, 2019, at noon

Opening remarks by President Rock Jones followed by student poster presentations

THE MAKING OF A SCIENTIST

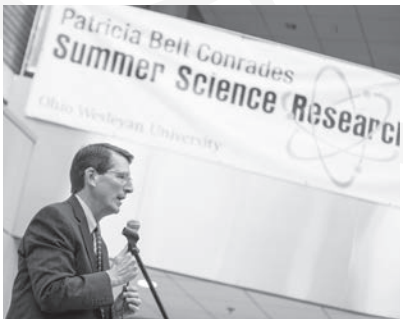
In Ohio Wesleyan's Summer Science Research Program (SSRP), students learn quickly that authentic research is quite different from classroom labs—more challenging, more creative, more frustrating, and, ultimately, more rewarding.

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, 8 students from universities other than OWU who worked on campus with OWU faculty, and 10 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.

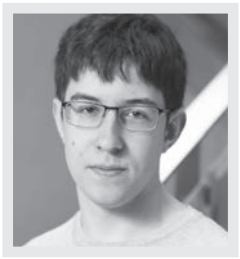
Through her contacts with SSRP participants, Ms. Ferry has observed how the program introduces students to the excitement of science and original research and provides familiarity with the many career options available in the disciplines.

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 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

ANTON KRAMSKOI



Research Mentor: Sean McCulloch
Department of Mathematics and Computer Science

This research aims to create an intelligent program to play Eurorails and win in as few turns as possible. Eurorails is a board game where players build track and sell goods to cities on a map of Europe. The goal of Eurorails is to be the first player to reach a certain amount of money. This program works by looking at a list of potential plans of actions that can be done, then picking the one that makes the most profit per turn.

ARTIFICIAL INTELLIGENCE FOR THE BOARD GAME EURORAILS

Eurorails is a board game where players control locomotives that move around a board on self-placed tracks and transport goods between cities. Each player has a set of demand cards that show what goods can be delivered with corresponding profits; every delivery, new demand cards are drawn to replace old ones. Players can place track between tiles at varying costs to make paths between cities. The goal of the game is to make a certain amount of total money and connect 7 of the 8 major cities together with placed track. Players compete to reach this goal first and win the game.

This research aims to make an AI player that attempts to win in as few turns as possible. The computer player moves by first generating all combinations of moves that it can perform in its current state. It then discards any plans that are invalid or impossible, and picks the set of moves that maximizes profit per turn. “Profit per turn” for a plan is calculated based on total profit made on that plan, as well as the total money spent on tracks and the total moves taken to complete it. The specific tracks to place and path to take are calculated with the A* algorithm, with movement cost as a heuristic. When it has enough money to do so, the AI also tries to upgrade its locomotive to improve its cargo or speed. As it approaches a certain threshold of money, the computer player preemptively connects major cities with track to secure a faster victory. In one data set, the current iteration of this AI manages to win in 60 turns; faster than some experienced human players.

Board 2

KAIT AROMY

Research Mentor: Nathan Rowley
Department of Geology and Geography

A healthy ecosystem is all about balance; but invasive honeysuckle has made that a distant memory for the Melvin Preserve. This small preserve is also home to a stream of the Delaware Run, constantly being polluted by runoff from the nearby roads and parking lots. To restore balance to the preserve, we fly drones overhead to better visualize and track the progress; as well as consistently test the soil and water quality. The plan is to use different sections of the Melvin preserve to test which is the best way to get rid of honeysuckle (either with chemical herbicide, or uprooting them entirely), as well as helping the stream recover.

RESTORATION OF THE MELVIN PRESERVE

The Melvin Preserve is a small parcel of land, donated by the family of alumna Ruth Melvin. Over its untouched years, the preserve has become overrun by invasive *Lonicera maackaii* (Amur Honeysuckle). A small tributary of the Delaware Run also transects the preserve, collecting runoff from the surrounding impermeable surfaces. The health of the preserve is assessed through a combination of mapping, remote sensing, and direct monitoring through soil sampling and water quality testing. The future of the Melvin Preserve is to use subsets as testing grounds for honeysuckle management methods (glyphosate application and physical removal), and to find an appropriate form of runoff mitigation for the stream.

Board 3

BRIANNA GRABER

Research Mentor: Shala Hankison
Department of Zoology

My research this summer involves observing the chemistry of a waterway by chemical analyses and aquatic insect sampling in order to check the water quality of the Delaware Run as a whole. In order to monitor the water quality, I will be installing a net system in the Delaware Run behind Merrick Hall that will collect trash and green debris from the water in order to improve the quality of the water

EFFECTS OF A STORM DRAIN NET ON WATER QUALITY AND MACROINVERTEBRATES IN THE DELAWARE RUN

Trash and debris can have a major impact on our local waterways. I determined the impacts of a storm drain net located in the Delaware Run behind Merrick Hall. There is little research on this topic, so the long-term results of this study will provide a new baseline data set that could be widely applied. Water quality parameters such as orthophosphate, ammonia, nitrate, dissolved oxygen, free and total chlorine, pH and temperature were measured upstream and downstream of where the net was located along with water conditions such as flow, clarity and current weather. Vegetation (amount of shade present in the given sample area), aquatic wildlife (fish and snakes counted in the given sample area), and terrestrial wildlife were also counted. In addition, macroinvertebrate sampling was done upstream and downstream of the net. This research will allow us to understand the effects of removing trash and green debris from the waterway and allow us to look at possible chemical improvements.

Board 4

DEXTER ALLEN

Research Mentor:
Robert Haring-Kaye
Department of Physics

The nucleus of an atom is not always spherical. Often it is shaped like either a frisbee disc or an American football. We can indirectly infer these shapes by measuring the time that it takes for a nucleus to relax from higher to lower energy. The goal of my research was to infer the shape of a particular isotope of selenium (Se-73) when it rotates rapidly.

LIFETIMES WITHIN THE 73SE NUCLEUS

There is considerable uncertainty in the literature regarding the cascade intensities of the various decay sequences in ^{73}Se. In particular, the degree to which each state is populated by direct and unknown side feeding can vary considerably. Such variations can cause significant uncertainty in the determination of state lifetimes and thus the transition rates inferred from them. Thus the goal of this work was to measure as many lifetimes as possible in ^{73}Se by gating from above the transition of interest in order to eliminate the effects of uncertainties in direct feeding intensities and unknown side feeding. This was made possible by the excellent gamma-ray counting statistics for ^{73}Se provided by the ^{14}C(^{62}Ni, 3*n*) reaction performed at Florida State University using a beam energy of 50 MeV and with a Compton-suppressed Ge detector array consisting of 3 Clover detectors and 7 single-crystal detectors. The Doppler-shift attenuation method, which compares the slowing-down time of recoiling nuclei in a target with their decay time, was used to measure all lifetimes. Seven lifetimes were measured, four within the strongest positive-parity band and three within the favored negative-parity band. From these lifetimes the quadrupole deformation parameter beta_2 could be inferred as a function of spin and compared with those predicted for these states using total Routhian surface calculations. In general, the variations observed in the experimental values were not reproduced in the calculations.

Board 5

SHANNON AGLER
LOGAN RICE

Research Mentor: Danielle Hamill
Department of Zoology

Our lab believes we have found a new species of nematode, a microscopic worm. While, the study of the *C. elegans* nematode has lead to great scientific advancements, we believe the study of other nematode species would further our knowledge of animal biology. We are comparing data we collect to published information to fully describe this new species.

CHARACTERIZATION OF RHABDITID NEMATODES

Nematodes are small worms used throughout the world for study and research due to their abundance and importance in medicine and agriculture, among other things. *Caenorhabditis elegans* is the most studied species of nematode, and has lead to great scientific advancements. While there are thousands of known nematode species, it's been predicted hundreds of thousand have yet to be described. We believe the study of these other nematode species will further our knowledge of animal biology. Our research focused on the characterization of Rhabditid nematodes isolated in Ohio and Florida by previous students in the lab. We focused on three worm groups, separated into "types" by genetic and molecular analysis. Based on the 18s rDNA sequence, type 1 worms match the described species *Oscheius myriophila*. We found that type 2 worms at this locus differ in their DNA sequence from *O. myriophila* by approximately 2%, and type 3 worms were about 1% different from both type 1 and type 2. We also observed the early embryonic development of these worms, which further supported their classification as part of the genus *Oscheius*. These embryonic phenotypes are being further characterized. We performed mating crosses between type 1 (*O. myriophila*) and type 2 worms. It appeared the worms were unable to mate and produce hybrid offspring, further supporting type 2 worms being a different species than *O. myriophila*. We measured and compared anatomical morphology between all three worm types. Differences in adult hermaphrodite morphology suggested type 2 and type 3 worms are both distinct and previously undescribed species. While there is still work to be done in characterizing these species fully, our work has furthered our understanding of this unique and important genus of nematodes.




Board 6

ABBI TURNER

Research Mentors: Dustin Reichard and Elizabeth Schultz
Department of Zoology

Our study focused on mate switching behavior in a common, backyard songbird, the House Wren (*Troglodytes aedon*). Mate switching is essentially a divorce where at least one member of the pair leaves to find a new mate. We were interested in determining if mate switching is beneficial by studying whether the adults who switched mates had more offspring than the adults who did not switch mates. To measure switching behavior and offspring production, we attached unique combinations of colored bands to the legs of adult wrens and observed which wrens paired together and also collected blood samples from both adults and nestlings for paternity testing.

IS MATE SWITCHING AN ADAPTIVE BEHAVIOR IN HOUSE WRENS?

The quality of an individual's mate directly affects their fitness. When mate quality is poor, e.g., low parental effort, poor body condition, reproductive success can be low. Mate switching is a behavior that occurs in many avian species that could potentially increase reproductive success in individuals that are initially paired with low-quality mates. This behavior occurs when a pair bond is severed, a new mate is found, and a new pair bond is formed. Mate switching is most commonly observed between breeding seasons, but multi-brooded house wrens (*Troglodytes aedon*) will frequently switch mates within a single breeding season between nesting attempts. We studied mate switching behavior in house wrens to examine its potential adaptive value. We caught male and female house wrens using mist nets, and blood samples were collected to measure circulating glucocorticoid hormones associated with stress and collect DNA for paternity testing. We banded each individual with a unique color combination to identify them while observing pairing and parental care behavior. We hypothesized that individuals who switched mates would not have higher fitness than the individuals who did not switch mates with fitness being measured as the number of offspring that fledge. Data analysis for this study is ongoing, but preliminary results suggest that mate switching is common in our population regardless of whether or not the first breeding attempt is successful.

Board 7

KARLI BIGLER

Research Mentor: Leah B. Manning
Department of Psychology

My research seeks to shed light on how the relationship between child and parent impacts a child's development and psychological well-being. By gathering results from over 16,000 published studies on this topic, multiple meta-analysis will be created. This will allow us to draw general conclusions about how the relationship between child and parent influences the child.

META-ANALYSIS OF CHILD/PARENT ATTACHMENT

The attachment relationship between child and parent has been shown to have a crucial impact on development and psychological well-being. While research has investigated this relation, no comprehensive review has investigated the impact of child–parent attachment relationship across all ages. The purpose of this study is to eventually conduct a meta-analysis investigating the various ways the child–parent relationship impacts a child's life outcomes. A scoping review using PyschINFO gathered all published studies on child–parent attachment and measures of attachment (e.g., AAI, SSP, AICA). Approximately 16,000 studies have currently been gathered, with this process ongoing. The next steps include organizing these studies into groups based on shared characteristics. Multiple meta-analyses will be completed on these smaller organized subsets. The findings will draw general conclusions about the way that research has addressed the impact of the bidirectional child–parent attachment relationship and which topics have been investigated up to date on child–parent attachment.

Board 8

JENELL BETTS

Research Mentor: Shala Hankison
Department of Zoology

In the fish species sailfin molly, males perform courtship displays to attract females. Our objective was to determine if the length and/or number of displays performed is related to the number of babies that the male fathers. We first paired a female with two males and observed and recorded their courtship behavior. Once the females have babies, we will do paternity tests on each of them, and determine which of the two males fathered more offspring.

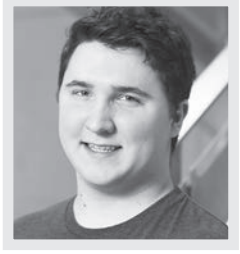
PATERNITY AND MATING BEHAVIORS IN THE SAILFIN MOLLY

Patterns of courtship displays and mating preferences may be important in understanding how variation within and between species arises. Sailfin mollies (*Poecilia latipinna*) are an interesting species of fish because females will often mate with multiple males and there may be multiple fathers within one brood. In this mating system females may choose the highest quality males to increase her odds of having many healthy offspring. Our objective was to determine whether courtship behavior consistently correlated with the proportion of offspring fathered. Pairing two males with a receptive female, we recorded courtship and competitive behaviors. When the female gives birth, we will collect DNA samples from all offspring, from the female, and from both potential fathers. Then, we will amplify eight different microsatellite loci on the DNA to determine paternity. We plan to calculate the proportion of offspring fathered by each male to determine whether the number or length of courtship displays correlates to the proportion of offspring sired. We predict that males who perform more or longer courtship displays will father more offspring. Overall, this study will help us better understand how mating strategies relate to actual reproductive success.

Board 9

HIEN MAI
BRAD ORZOLEK

Research Mentor: Kira Bailey
Department of Psychology/
Neuroscience Program



Playing action video games is associated with changes to visual information processing, goal-directed behavior, and brain function. Commercial video games utilize proprietary complex mechanics with heavy graphics that make it difficult to match stimuli with specific brain activity. By building our own video game, we can directly control the stimuli to better understand which game features impact behavior and brain function.

STUDYING COGNITIVE CONTROL AND BRAIN FUNCTION IN A VIDEO GAME

A growing body of evidence suggests that action video game (AVG) experience is associated with improvements in visual/spatial attention and cognitive control (Green & Bavelier, 2003, 2006, 2007; Green, Pouget, & Bavelier, 2010) and changes in brain function (Knols et al., 2017). The significance of this finding lies in the implication that the skills acquired in an AVG might be transferred to other contexts (Boot, Blakely, & Simons, 2011; Green & Bavelier, 2003). This has led some researchers (Bavelier et al., 2012; Green & Bavelier, 2008) to recommend the use of AVGs in training protocols among populations that would benefit from enhanced visual attention and cognition (e.g., older adults, pilots, military personnel). These recommendations may be premature, however; there are several methodological criticisms of the past research (Boot, Blakely, & Simons, 2011; Bisoglio et al., 2014), one of which is that the use of readily available commercial video games does not allow for strong experimental control over the numerous variables that could influence cognitive skills. At this point it is nearly impossible to know what features of a given video game are training which cognitive skills. Using the Unreal Tournament 4 engine we are designing video games that will allow researchers to better understand which game features impact cognitive control and allow for the simultaneous recording and analysis of brain activity.

Board 10

ALIYAH HANNIG

Research Mentor: Nathan Rowley
Department of Geology and Geography

I have been monitoring the Delco reservoirs for algal bloom susceptibility. I used a data sonde which measures water quality variables such as pH and Chlorophyll levels. I also used a drone to fly over the water to monitor algae from the air. A trend I noticed is that the more acidic pH and the higher chlorophyll levels, the higher the threat of algal blooms within the drinking water reservoirs.

MONITORING THE DELCO RESERVOIRS FOR ALGAL BLOOM SUSCEPTIBILITY

The Delco reservoirs are drinking water reservoirs located in Delaware Ohio. Being that they are an open reservoir with no shade coverage, they are susceptible to algal blooms. Algal blooms are made up of cyanobacteria, which are a phylum of bacteria that thrive on photosynthesis. A treatment option that we enacted is the use of phosphorus to treat the water and get rid of the cyanobacteria. It has to actively be sunny for this treatment option to work, because the cyanobacteria have to actively be feeding in order to absorb the phosphorus.

Board 11

AKUL RISHI

OHIO WESLEYAN UNIVERSITY

VICTORIA BOEHM

PENN STATE UNIVERSITY

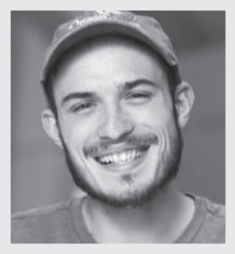
Research Mentor: Robert Harmon
Department of Physics and Astronomy

The purpose of this project is to better understand the magnetic activity of stars including our own sun. To do so, we are studying the star LO Pegasi, located more than 80 light years away in the Pegasus constellation. We are observing its star spots which are cool, dark, magnetically active regions on the star's surface, formed due to a strong magnetic field generated within the star. We are observing changes in brightness of the star with time to determine how spotted it is and based on data gathered from 2014-2019, we attempt to create tentative models of the star's surface depicting possible spot locations.

IMAGING STARSPOTS ON LO PEGASI, 2014-2019

LO Pegasi is a K8 main-sequence star located 81.7 light years away. It is an ultrafast rotator with a period of 10.153 hours. This short rotational period makes LO Pegasi magnetically very active, with Doppler imaging suggesting the presence of much larger starspots on its surface than those on the Sun. As rotation brings these dark spots into and out of view, the star's overall brightness varies, becoming dimmer when the spots are visible. We acquired CCD images of LO Pegasi through standard photometric B, V, R, and I filters, then analyzed them using differential photometry. The data thus gathered were processed via the Light-curve Inversion algorithm to create surface models of LO Pegasi. We present a series of models made using data acquired from 2014 to 2019 in order to study how the spots on its surface are changing with time.

Board 12



DUSTIN BRADEN

Research Mentor: Ashley Allen
Department of Geology and Geography

I evaluated the communications and outreach methods of urban farms in Columbus, Ohio. Food production requires an understanding of a variety of scientific concepts such as soil and plant health. To explain these concepts to the general public, the farms relied on strategies ranging from posters and events to social media and websites. My project gathered these various communications materials with the intention of evaluating their effectiveness to create a communications model that other urban farms could use to improve their communications and outreach programs.

EVALUATING URBAN SUSTAINABILITY EFFORTS IN COLUMBUS, OHIO

As food sustainability efforts increase around the world, a vital piece to community support and engagement in the process is communication from producers to their consumers. This project evaluates communications and outreach efforts in Columbus, Ohio from urban food producers. Food production requires an understanding of a variety of scientific concepts ranging from soil and plant health to garden ecology, made even more complex by the urban environment. As such, the outreach strategies utilized by urban producers is a form of science communications. I employed multiple methods for data collection, including interviews, site visits of urban/suburban food production areas, and a thorough social media/website review of several urban gardens. The social media and website inventory can be used as a template to improve digital communications, while interviews and site visits provided a local background and understanding of physical communication efforts from the gardens. Preliminary findings show that the urban garden groups employ a variety of communication strategies including flyers, social media, websites, and oral communication. In the future, we hope to create a model for a wide-ranging communications plan to guide other urban producers in improving their science communications through evaluating each of these strategies.

Board 13

MOIRA MEEHAN
ABBI TURNER

Research Mentors:
Dustin Reichard and
Elizabeth Schultz
Department of Zoology

Everyone knows that we get sick more often when we are stressed. However, some evidence suggests that different types of stress have different effects on the immune system. Our study examines short term stress by presenting house wrens with a fake predator at their nest box and collecting blood samples to test whether the encounter with the predator affects their immune function.

STRESS AND IMMUNITY IN HOUSE WRENS

All organisms have a finite energy budget, and changes in the environment often affect how energy is allocated between different physiological processes. Chronic stress is generally understood to have a suppressive effect on the immune system, however, some evidence suggests that short term stress has the opposite effect. For example, exposure to a predator may result in more energy being allocated to the immune system in anticipation of an injury. We tested this hypothesis in house wrens (*Troglodytes aedon*) by presenting females with 3-6 day old nestlings with a model of a black rat snake, a common nest predator. The model was left on a nest box for five minutes, and the behavior of the female was recorded. The female was then caught within 15 minutes post trial, and a blood sample was taken and used to measure constitutive immunity. These samples were compared to females that were not exposed to the snake model, but at the same nesting stage. Previous data from 2018 were consistent with our hypothesis that a short term stressor would enhance immune function. However, data collected this summer showed no clear effect of the short term stressor, which suggests that another factor, such as environmental variation, is also affecting the immune response.

Board 14

KAYTLIN WARD

Research Mentors: Allen J. Pistner and David C. Lever
Department of Chemistry

I am continuing research from previous years to find an effective route of synthesizing an organic molecule called a dipyrrin. The molecule can be used in targeted cancer treatment and fuel cells. One of my goals is to create more conjugation within the dipyrrin which will increase the effectiveness for photodynamic therapy, a type of cancer treatment. I also hope to modify the synthesis to avoid air-sensitive reagents and allow for repeatability.

REDOX-ACTIVE LIGAND SCAFFOLD FOR THE ACTIVATION OF OXYGEN

A redox-active ligand scaffold, dipyrrin, was synthesized for applications of activating oxygen. The synthesis of the ligand was modified from previous pathways. The original pathway used a Negishi coupling followed by condensation with an aryl aldehyde using pyrrole and di-tert-butyl phenol. The modified synthesis constructs the ligand with a Suzuki cross-coupling followed by condensation with an aryl aldehyde. A Suzuki coupling allows for the use of more stable reagents and potentially increase efficiency of the synthesis. The modified synthesis also uses naphthol instead of di-tert-butyl phenol to increase conjugation for redox activity. The ligand scaffold was successfully synthesized using the naphthol; however, the Negishi coupling was required. The necessary boronic acid for Suzuki coupling proved difficult to make and purify. Further investigation of the Suzuki coupling is currently underway.

Board 15

MICHELLE DE OLIVEIRA

WHEATON COLLEGE

NATALIE HUEBSCHMAN

OHIO WESLEYAN UNIVERSITY

REID MATHEISON

ASBURY UNIVERSITY

Research Mentor: Pamela Pyzza
Department of Mathematics and Computer Science

In this project we modeled the spread of ideas and how that affected the spread of measles throughout a community. To do this we used a software called MATLAB to create a mathematical model. Using this model we hope to be able to answer some questions about what might cause outbreaks and how it might be possible to contain these outbreaks.

THE ANTI-VACCINATION MOVEMENT'S EFFECT ON WORLD HEALTH

Measles is a highly contagious viral infection that, after being labeled "eradicated" by the CDC in 2000, has resurfaced with a growing number of cases due to the increasing amount of parents refusing to vaccinate their children. A feature contributing to unvaccinated cases are online communities popularizing the idea that vaccines increase a child's likeliness of developing autism. To further investigate the link between anti-vaccination ideology and the physical spread of measles through a population, we developed a mathematical model. MATLAB was utilized to build an Agent-Based Network of individuals with unique characteristics. Each is connected to others of a similar age range for the work week and four other individuals during the weekend to represent school and familial interactions respectively. Using these connections, measles is spread throughout the population-based on connecting an individual's disease status. Whether an individual is vaccinated or affected by the disease depends predominantly on how the anti-vaccination ideas spread through the social media platform. This model provides the foundation for further research on how these ideas can affect different societies based on different geographical, social, or age-based relationships.

Board 16

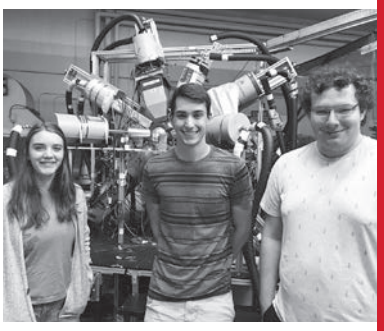
LEXIE CHAFIN
CLAUDIA KELLY
BRAYAMS AYALA RAMOS

Research Mentor: Chris Wolverton
Department of Botany and Microbiology

As everyone knows, plant stems grow up towards the sun and their roots grow down into the ground. How do they know which way to grow? Cells in the root tips of plants contain starch-filled organelles, called amyloplasts, which are heavy and settle at the bottom, causing the roots to grow downward. Scientists have found, however, that roots still grow down even when they are missing these amyloplasts. Our lab is researching to find the genes that cause plants to respond to gravity even when they are mutated to not have starch. We are accomplishing this by growing plants with over thirty different single mutations in the genes that are expressed in gravity response and recording the growth and angles of the root tips in every plant. Our goal is to narrow down a list of genes that are active in plant gravity response, even when plants have no starch, in order to get a better understanding of the processes by which plants grow successfully.

SEARCHING FOR COMPONENTS OF THE NON-STATOLITH GRAVITY SENSING SYSTEM IN PLANTS

Gravity is a ubiquitous and persistent force on Earth and serves as one of the most important cues underlying plant architecture and directing plant growth. One system plants use to transduce this physical force into cellular information is based on the sedimentation of dense, starch-filled organelles called amyloplasts, which act as statoliths in the cell. Throughout seedling establishment and early growth, statolith sedimentation activates a series of signaling events that regulate differential growth, maintaining organs in a particular position within the gravity field. Despite the central role of statolith sedimentation in mediating gravity responses, work in our lab and others have shown that plants maintain some degree of gravity responsiveness even in the absence of starch-filled statoliths, which suggests the function of another sensing system. We used RNA-seq to identify differences in early (10 min post stimulation) gravity-responsive genes in wild-type and starchless mutants (see Meyers et al., this program). Here we report the initial screening and phenotypic characterization of mutants in approximately 30 candidate genes revealed through the differential gene expression analysis. In addition to typical gravitropic phenotype analysis through image analysis on free-responding root tips, we introduce a novel approach to identify deficiencies in gravity response parameters based upon our previous feedback-based rotation system, ROTATO. By subjecting seedlings to constant rotation at a fixed rate using a programmable motor control circuit, we were able to identify differences between mutants and wild-type responses more readily than with free response assays alone. The simplicity and low cost, coupled with the ability to subject multiple seedlings to the treatment at a time, make this a potentially useful tool for the community. Results of the ongoing mutant analysis and potentially exciting candidate genes will be discussed.



Board 17

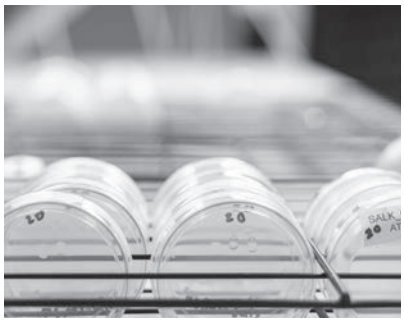
BENJAMIN W. ARNOLD

Research Mentor: Raphael A Nemenoff
Department of Medicine, University of Colorado Anschutz Medical Campus

While one of the fastest-growing treatment options for many cancer patients is immunotherapy, the complicated nature of non-small cell lung cancers (NSCLC) produces an interesting finding in patients: only 20% of unselected NSCLC patients respond to immunotherapy. Our lab has shown that treating these cancer cells with IFNγ may increase the efficacy of immunotherapy, but even still, some cell lines do not elicit the effects of IFNγ treatment and remain unresponsive to immunotherapy. Therefore, we hypothesized that coupling IFNγ with TSA – a molecule known to upregulate gene transcription – may increase the effectiveness of IFNγ treatment and induce responsiveness to immunotherapy.

COUPLED IFNγ AND EPIGENETIC TREATMENT MAY INCREASE K-RAS MUTANT NSCLC PATIENT SENSITIVITY TO IMMUNOTHERAPY

While lung cancer is the leading cause of cancer death worldwide, only 20% of non-small cell lung cancer (NSCLC) patients – accounting for 85% of the lung cancer population – are responsive to anti-PD-1/PD-L1 immunotherapy. Although previous findings in our lab suggest that IFNγ treatment can increase immunotherapy sensitivity by upregulating JAK/STAT signaling in K-Ras mutant cancer specific cells, some cell lines are unresponsive to treatment for unknown reasons. Downstream genes of the JAK/STAT signaling pathway – namely *Cxcl9, Cxcl10, Cd274* (PD-L1), *Ciita*, and *Socs1* – whose upregulation results in remodeling of the tumor microenvironment and increased cancer cell antigen presentation. We therefore hypothesize that IFNγ responsiveness can be induced by targeting epigenetic pathways by histone deacetylation inhibition, thus increasing patient sensitivity to immunotherapy. IFNγ alone resulted in upregulation of downstream antigen presentation genes in only some of the human K-Ras mutant cell lines in our working panel, including A549, H358, H441, and Calu6. However, target genes of H2030, H1573, and SW1573 cells were uninducible. When the same experiment was repeated with four cell lines – A549, H358, SW1573, and H1573 – and IFNγ treatment was coupled with TSA, a known pan-HDACi, our data suggests that H1573 and SW1573 are still unresponsive to IFNγ, while the coupled TSA-IFNγ treatment amplified the effects of TSA or IFNγ for the A549 and H358 cells. This finding infers that HDAC inhibitors could be used to increase K-Ras mutant NSCLC patient sensitivity anti-PD-1/PD-L1 immunotherapy, but only in cell lines previously found to be responsive to immune checkpoint inhibition via IFNγ treatment alone. Our data suggests a mechanism alternative to epigenetic regulation as the driving force behind SW1573 and H1573's unresponsiveness. Ultimately, coupled epigenetic and IFNγ treatment shows mild promise in enhancing K-Ras mutant NCSLC response to immunotherapy.

Board 18

JENELLE COLLIER

Research Mentor: Nicola Grissom
Department of Psychology, University of Minnesota

Neurodevelopmental disorders such as Autism Spectrum Disorder are significant for their genetic variant risk factors and family inheritance genes as mechanisms for development. In this project, we have used mice to model a well-associated genetic risk factor with Autism Spectrum Disorder, chromosome 16p11.2 hemi-deletion. This variant has been shown to alter areas of the brain involved in reward and movement. Our goal was to see how amphetamine, a drug that elevates dopamine in the brain, affects dopaminergic activity and how that activity leads to the development of repetitive behaviors in 16p11.2 hemi-deletion and wild-type mice.

A MOUSE MODEL FOR NEURODEVELOPMENTAL DISORDERS SHOWS AN INCREASE IN AMPHETAMINE-INDUCED STEREOTYPICAL BEHAVIORS

Neurodevelopmental disorders, especially autism spectrum disorders, are associated with multiple etiological mechanisms and symptom presentations. However, a core symptom across autism-spectrum disorders are repetitive locomotor behaviors. Autism is a highly genetic disorder, and one of the most frequently associated genetic variants with autism is chromosome 16p11.2 hemi-deletion. More than 30 percent of carriers have an autism diagnosis. In a mouse model of 16p11.2 hemi-deletion, gene expression and protein levels related to dopaminergic function in the striatum were disrupted. The striatum regulates locomotor behavior via dopaminergic input. This suggests that repetitive behaviors in autism may be driven by altered dopamine activity in the striatum. A well-validated technique for evaluating striatal dopamine function and locomotor behavior in mice is amphetamine-induced locomotor sensitization, which we tested in 16p11.2 hemi-deletion model mice. In response to daily amphetamine, wildtype mice increased their distance traveled, but the increase was less prominent in the 16p11.2 del mice. Instead, the 16p11.2 del mice performed stereotyped rotations, which was not seen in wildtypes. These data suggests a difference in sensitivity to dopamine stimulation in 16p11.2 mice that promotes repetitive behavior, supporting the possibility of dopaminergic dysregulation in the striatum in autism-related genotypes.

Board 19

SAM MILLER

Research Mentor: Herbert DuPont
Department of Infectious Diseases at the UTHealth School of Public Health

Antibiotics not only kill the bacterial infection that your doctor identified, it also kills the bacteria in your gut that helps you digest food. This leaves your gut open to antibiotic resistant bacteria which is bad for your health. *C. diff* is one of these kinds of bacteria which releases a toxin in your gut that causes diarrhea. We looked at if commercial probiotics were able to stop *C. diff* infection and our conclusion was that there were varying effects ranging from effective to ineffective.

EFFECT OF COMMERCIAL PROBIOTICS ON *C. DIFFICILE* SPORULATION

C. difficile infection (CDI) is the leading cause of both hospital and antibiotic associated diarrhea worldwide. The major complication of CDI is recurrence, seen in 25% of cases. A large percentage of these cases with recurrence are not cured by antibiotics because of presence of spores in the gut which germinate when antibiotics are withdrawn leading to further recurrences. *C. difficile* spores are resistant to extreme temperatures and from usual alcohol disinfectants used in hospitals. Currently there is little research into the effects of commercial probiotics and their effects on CDI. In this study we looked at five popular commercial probiotics and their impact on inhibition of sporulation of two different strains of fully virulent and toxigenic *C. difficile*. All combinations of probiotic and strain were plated along with the necessary positive and negative controls and were grown for a week to allow spores to form. After the week incubation the samples were placed in a hot water bath to kill any remaining bacteria so the spore counts would be accurate for the week of growth. Then each sample was plated at 4 dilutions: 1x, 10x, 100x, and 1000x and were incubated for 48 hours to allow for visible spores to form on the plates. Counts were then taken of each plate and compared to the controls. PCR was also run on samples with spores to ensure that they were *C. difficile* and not spores of the probiotics. We found that both Bio-K Plus and Bio Schwartz probiotics reduced the *C. difficile* spore counts from their maximum strength to no more than two spores for any given dilution. The rest of the probiotics had varying effects on spore counts, none of which were as effective as the two previously stated. We concluded that available probiotics differ in their ability to prevent sporulation of *C. difficile*, and potential value in preventing recurrence of CDI.

Board 20

EMMA HALL

Research Mentor: Karl Clark
Department of Biochemistry and Molecular Biology, Mayo Clinic, Rochester Mn

When faced with a threat, animals respond in a distinct way called the stress response (SR). Concurrently with the fight-or-flight response of the nervous system, SR takes effect within minutes maintaining the body's energy levels (e.g. blood sugar) while causing rapid behavioral changes. However, there is little known about the genes responsible for this rapid SR. Using zebrafish and focusing on one gene (*fkbp5*) known to play a role in long-term SR, we found that *fkbp5* also participates in rapid behavioral SR. We aim to discover new genes for rapid SR and increase our understanding on the relationship between rapid and chronic SR.

STRESS, LOCOMOTION, AND ZEBRAFISH MUTANT ANALYSIS

The stress response (SR), mediated through the hypothalamic-pituitary-adrenal (HPA) axis, is an organism's reaction to threats to homeostasis. Proper SR is essential for survival and fitness, but exaggerated or chronic activation of SR leads to stress-aggravated disorders including depression and post-traumatic stress disorder. However, there is minimal understanding on the role of rapid SR in stress-associated disorders. Within a few minutes of HPA axis activation, a hormonal cascade results in the secretion of glucocorticoids from the adrenal gland in humans and from the interrenal cells (HPI axis) in zebrafish which dictates the behavioral and physiological responses of an organism. Because of the quick timeline, SR excludes transcription-dependent response that require gene expression changes. *fkbp5*, a co-chaperone protein that binds to glucocorticoid receptor (GR), has been implicated in decreased glucocorticoid receptor activity. Replacing *fkbp5* with *fkbp4* renders GR more free, increases GR binding affinity to cortisol, and allows GR to translocate into the nucleus more efficiently. We hypothesized that abrogating *fkbp5* function will increase locomotor response to acute stressors. To test this hypothesis, we used zebrafish with a frameshift allele (116 bp deletion) in exon 2 of *fkbp5* and subjected larval zebrafish (5 days-post-fertilization) to abrupt light changes. *fkbp5* heterozygous and homozygous fish showed significantly increased locomotion after 1-min white light illumination [baseline (15-min infrared (dark)) – white light (1 min) – post-treatment (30-min infrared)] and in a repeated 7.5-min dark-light cycling assay. Our findings indicate a role for *fkbp5* in rapid SR. Current work is focused on generating "knock-in" mutant strains to compare the phenotypes with frameshift mutants. Our behavioral assay-based approach may discover novel genetic modifiers of rapid stress response.




Board 21

LANDRY COWLES

Research Mentor: Tim Nelson
Mayo Clinic

Stem cell therapy is a promising method of treatment for a variety of diseases and disorders, but numerous complications can arise due to variability in cell lines derived from different patients or even in a patient's own stem cells. To identify the highest quality induced pluripotent stem cell (iPSC) colonies, rigorous testing must take place to ensure each cell product meets or exceeds characteristics essential for successful clinical application. After clones are differentiated to cardiac cells and satisfy additional release criteria, they are ready to be evaluated for safety and efficacy in an in vivo model system mimicking that which is proposed for the treatment of Hypoplastic Left Heart Syndrome.

CHARACTERIZATION OF HUMAN INDUCED PLURIPOTENT STEM CELL (HIPSC) DERIVED CARDIOMYOCYTES

Human induced pluripotent stem cells (hiPSC) are emerging as an option for developing therapeutic treatments for a variety of medical afflictions. Fibroblasts obtained from skin biopsies and reprogrammed into iPSCs are commonly used in stem cell research, but have limitations due to excessive interclonal variability in pluripotency. Quality control is an imperative element of selecting clones to use in clinical study in order to obtain consistent products and avoid tumorigenesis. In addition to the previously accepted genomic DNA and gene expression analysis, research has shown etoposide sensitivity assay (ESA) to be a functional method in predicting hiPSC quality. A half maximal effective concentration (EC50) value of $\leq$ 300nM for ESA is correlated with a high quality iPSC profile. This analysis exploits iPSC hypersensitivity caused by etoposide, an inhibitor of the DNA unwinding enzyme topoisomerase II. After implementing a cardiac differentiation protocol, flow-based detection of troponin can validate cardiac-like characteristics of cultivated cells. The aim of this project is to differentiate and characterize hiPSC-derived cardiomyocyte-lineage cells to identify characteristics of iPSC clones undergoing the most robust differentiation. Clones determined to meet release criteria and pass characterization analysis will be further validated in animal studies to investigate product safety and efficacy regarding proposed treatment of Hypolastic Left Heart Syndrome. We expect to observe a positive correlation between increased ESA apoptotic rates and iPSC marker expression in the hiPSC clones, and thus their ability to successfully differentiate into cardiomyocytes.

Board 22

CATIE BABBS

Research Mentor: Stephen Greiman
Department of Biology, Georgia Southern University

As Grizzly bears were being reintroduced into Washington state, they were becoming sick and dying. The culprit was determined to be *Neorickettsia* SF agent bacteria that reside within *Nanophyetus salmincola* parasite that reside within Chinook salmon that the bears were eating. This project determined that the prevalence of *Nanophyetus salmincol*a parasite was high, while the *Neorickettsia* SF agent bacteria prevalence was low. Though the prevalence of the bacteria was low, any kind of prevalence could cause death in the Grizzly bears that were eating them.

ASSESSING BACTERIAL ENDOSYMBIONTS IN NORTHERN CASCADE SALMON INFECTED WITH *NANOPHYETUS SALMINCOLA* METACERCARIA

Current progress of the reintroduction of Grizzly bears into the North Cascades of Washington has been hindered due to an unknown pathogen. The culprit was eventually determined to be a bacterial pathogen transmitted by a parasitic worm, i.e. *Neorickettsia* SF agent. This bacterial pathogen is endosymbiotic within the digenean *Nanophyetus salmincola*, which use fishes as their second intermediate host. Grizzly bears were becoming infected with the parasite and subsequently the bacteria after ingesting infected salmon. Unfortunately, little is known on the strain diversity of this bacteria, the distribution or prevalence of the parasite (*N. salmincola*), or the distribution or prevalence of *Neorickettsia* SF agent. Therefore, this project had two major aims, determining the prevalence of the parasite *N. salmincola* and *Neorickettsia* SF agent bacteria. Kidney and muscle tissue of chinook salmon samples were collected from Wenatchee and Metatchee rivers and *N. salmincola* metacercariae (mtc) were isolated using a pepsin HCL solution. A total of 215 mtc were isolated from 105 salmon. Metacercariae were pooled into groups of 10 and DNA was extracted. DNA extractions were screened for the presence of *Neorickettsia* SF agent using a newly developed TaqMan real-time PCR assay. Samples testing positive were verified by nested PCR and sequencing of a 1900 bp fragment of the GroESL operon. Overall prevalence of *N. salmincola* mtc was high at 92.10%, while the prevalence of SF agent was low at 1.86%.

Board 23

HOLLY KEATING

Research Mentor: Britt Heidinger
Department of: Biological Science, NDSU

The Heidinger lab at North Dakota State University studies the effects of stress on house sparrows. In the current experiment, both parents and chicks are being stressed. Since stress has been known to reduce immune function, I tested to see how immune function compared between house sparrow nestlings of different treatment groups. I did this in two ways; firstly, at 10 days old the chicks are combed for parasites in order to determine if certain groups are more susceptible to them. Second, at 10 days old the chicks' wing web thickness is measured and then injected with PHA, a solution that evokes an immune response. Approximately 24 hours later, the wing was remeasured in order to measure swelling (the immune response).

EFFECTS OF PARENTAL AND NESTLING STRESS ON IMMUNOCOMPETENCY OF HOUSE SPARROW NESTLINGS: ECTOPARASITE SUSCEPTIBILITY AND IMMUNE RESPONSE

In the current experiment at Heidinger lab at North Dakota State University, stressing is done on both adult birds and nestling House Sparrows (*Passer domesticus*), with controls for both groups. As such there are four total groups: stressed parents-stressed chicks (S/S), stressed parents-control chicks (S/C), control parents-stressed chicks (C/S), and control parents-control chicks (C/C). Since stress has been known to reduce the immune function of certain species, it was tested to see if immunocompetency differs across treatment groups. First, ten-day old chicks were combed for ectoparasites in order to determine if chicks in certain groups were more susceptible to parasites. Second, ten-day old chicks also had their patagium thickness measured using Phytohemagglutinin (PHA) and phosphate-buffered saline (PBS) injections. The data showed that PHA wings were thicker than PBS wings, but there was no significant difference between PHA wings across treatment groups. Chick treatment had no effect, but there was a weak trend toward parental stress causing higher immune reaction in chicks. Preliminary data showed that S/C chicks may be more susceptible to ectoparasites, but this data was being skewed by one individual with an unusually high number of parasites. When this individual was removed from the data, there was no difference between ectoparasite susceptibility across treatment groups. It was concluded that there was no difference in immunocompetency across treatment groups. More data collected during a year with better weather and less mortality among nestlings may show better results.

Board 24

ISMAIL OZGENC

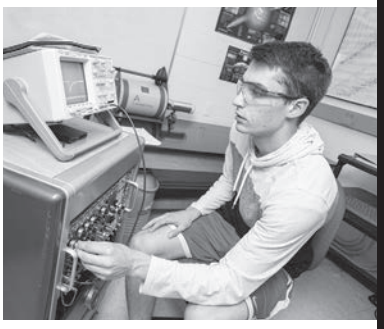
Research Mentors: Matthew Johnson[1] and Beth Stevens[2]
[1]Broad Institute of MIT and Harvard, Stanley Center for Psychiatric Research (Stevens Lab (Senior Research Scientist)
[2]Broad Institute of MIT and Harvard, Stanley Center for Psychiatric Research and Boston Children's Hospital (Principal Investigator, faculty member of Harvard Program in Neuroscience, Professor of Neurology)

Prefrontal Cortex of the brain is responsible for significant complex functions such as planning, social behavior, personality expression and decision making and a thorough investigation of the development of this important brain region can lead to new targets and explanations to developmental diseases, like schizophrenia. We investigated changing patterns of different types of inhibitory synapses as well as myelination at the prefrontal cortex with immunohistochemistry. Our preliminary results indicate critical developmental stages for inhibitory synapses as well as myelination.

INVESTIGATION OF SYNAPTIC AND CIRCUIT DEVELOPMENT IN PRE-FRONTAL CORTEX OF MOUSE BRAIN

Pre-frontal cortex is involved in numerous important functions with high complexity such as complex planning, cognitive behavior, personality expression, decision making and moderation of social behavior. Despite of its high complexity and involvement in diseases like schizophrenia, the refinement of prefrontal cortex has not been firmly researched. It is well known that inhibitory neurons are important as they regulate neural activity and it is critical to investigate and learn about the development of different inhibitory neurons in different layers of the prefrontal cortex. To do that, we have used immunohistochemistry on the rostral coronal mouse brain sections through development (P10, P15, P49, P120). These ages were determined by collecting/analyzing the electrophysiological data to see the critical timepoints of pruning in the prefrontal cortex of mouse. The brain sections were prepared as 14 microns by using a cryostat. To investigate parvalbumin (PV) interneurons, synaptotagmin-2 antibody was used at 1:1000 concentration which labels the synapses of PV interneurons (it is a pre-synaptic marker). Along with synaptotagmin antibody, vesicular GABA transporter (VGAT) antibody was used at 1:500 concentration which labels all the inhibitory synapses (it is a pre-synaptic marker). To investigate myelination over development of pre-frontal cortex, basic myelin protein (MBP) antibody was used at 1:1000 concentration and neural/glial antigen-2 (NG2) primary antibodies were used. Myelination is a significant illustration of maturation and it is critical to be able to know at what point it takes place. By using MBP, we targeted myelinating oligodendrocytes and with NG2, we targeted precursor oligodendrocytes. The images of medial, dorsolateral and ventrolateral prefrontal cortex were taken at layers 1 and ⅔ with a magnification of 60x with confocal microscopy. The is analyzed using CellProfiler and MATLAB/R programming, and our preliminary data suggests critical changing patterns of all inhibitory neurons in layers 1 and 2-3 as well as PV a different changing pattern of PV interneuron synapses,, which are one of the three inhibitory neuron subsets (interneurons in PFC are classified according to calcium-binding protein they contain. The other two subsets are calbindin and calretinin interneurons). Our preliminary results also show possible new explanations in terms of structure of inhibitory synapses over development.



Board 25

KATHLEEN TUGGLE

Research Mentor: Jonathon Payne
Brain and Mind Group at Murdoch Children's Research Institute, Australia

Neurofibromatosis type 1 is a disorder that impairs children's intellectual and social abilities with long-term implications. The goal of the many studies at the Murdoch Children's Research Institute Brain and Mind Group is to increase our understanding of NF1 along with other common disorders, such as autism spectrum disorder and attention-deficit/hyperactivity disorder, in order to personalize patient treatment and increase early identification. My clinical and laboratory research involvements provided widespread insight into the biological, mental, and social problems related to these disorders and the most appropriate treatments for effective intervention.

AN ANALYSIS OF NEUROFIBROMATOSIS TYPE 1 IN CHILDREN

Neurofibromatosis type 1 is a single-gene mutation disorder that affects the level of neurofibromin, a GTPase-activating protein involved in the RAS/MAPK pathway. NF1 is either inherited or occurs spontaneously. Children with NF1 experience neurodevelopmental delays and commonly develop physical symptoms such as neurofibromas and optic gliomas. Over the course of six weeks, I conducted a multimodal approach to the analysis of NF1 at the Murdoch Children's Research Institute in Melbourne, Victoria, Australia. During this time, I worked in both clinical and laboratory research settings via pediatric observations, literature reviews, data entry, and with stem-cells. NF1-associated autism spectrum disorder and attention-deficit/hyperactivity disorder was a pertinent area of focus as both ASD and ADHD are widely encompassing disorders with a variety of physiological roots. Additionally, ASD and ADHD have higher occurrence rates in NF1 when compared to the general population. Through the lens of NF1, the affected biological pathways and social behaviors are analyzed to best characterize and treat children as early as possible. Current clinical studies at the institution I assisted with include psychometrics, pragmatic language, audiology-RCT, and gender dysphoria. In the associated Victorian Clinical Genetics Services Laboratory, I worked closely with a PhD student to grow, split, freeze, and image patient-derived pluripotent stem cells. The project involves five children with NF1 and five matched controls. Their stem cells will undergo neural differentiation for future mechanistic analysis of the disorder. This experience demonstrated the vitality of multimodal research with direct clinical applications.

Board 26

JACK MAUTER

Research Mentor: Mitchell Grayson
Nationwide Children's Hospital in the Department of Allergy & Immunology

Recent experiments show that early viral infections are important in children developing asthma. The virus that is most responsible for causing these infections is called respiratory syncytial virus (RSV). This experiment aims to see if a type of white blood cell called a neutrophil is important in suppressing RSV from spreading in its host.

THE EFFECT OF NEUTROPHILS ON RSV REPLICATION IN HUMAN LUNG EPITHELIAL CELLS

Asthma is an incurable disease that lasts for life and affects eight percent of people around the world. Recent evidence suggests that early respiratory infections are a key factor in children developing asthma. The virus that is referenced the most to be causing these infections is respiratory syncytial virus (RSV). The objective in this project is to determine if neutrophils are causing inhibition of viral replication. Previous transgenic mouse experiments done in our lab with asthmatic mice suggested neutrophils may play a role in inhibitor of asthma like symptoms following viral infection. However, we did not see a significant reduction in viral replication. The objective of this project is to observe if neutrophils have an effect on viral replication. The experiments done for this project were all done in vitro using A549 cells and these cells are immortalized lung epithelial cells. The rational for performing in vitro studies was to determine the role of neutrophils on lung epithelial cells following viral infection without any other immunological interference. The strain of RSV being used has a GFP (green fluorescent protein) inserted into its genome. This allowed easy observation of viral replication when observed under a fluorescence microscope. Neutrophils were enriched from human peripheral blood. Live and inactivated neutrophils were tested for the effect on viral replication. What was found went against the hypothesis and the data showed neutrophils inhibit viral replication. However, the enriched neutrophils population had other cell types. Therefore, further experiments are being done to confirm if pure neutrophils are responsible for the current results.

Board 27

LEIA ASHIKAWA

Research Mentor: Courtney Thatcher
Department of Mathematics, University of Puget Sound

There are ten different criterias in which a state can take to court whether or not a Congressional district map is gerrymandered. One of the criterias being communities of interest, we used the map of Ohio to examine the clusters of communities of interests, in order to identify patterns that could be used for a potential Congressional district map.

MAPPERING COMMUNITIES OF INTEREST

Congressional redistricting is mandated by federal law at least once every ten years. However, states control the formation of Congressional districts. There are ten factors established where states can challenge redistricting plans. One example is communities of interest, which are groups that share similar demographics including economic interests, socioeconomic status, and political ideologies. Redistricting of these groups were specifically studied due to their high tendency of being manipulated. Orchestrating the districts can easily be used to dilute the voting strength of specific communities to favor one political party. To study these changes, two forms of cluster methods were used: hierarchical clustering and the Mapper algorithm. Outputs from both cluster methods were used to detect and compare these communities. Census data collected from Ohio back in 2010 was emplaced into an Ohio shape file utilizing block group data regarding age, income, race, veteran status, and industry. Due to time restrictions, emphasis was placed on Cincinnati, Cleveland, and Ohio as a while when inputting the logged data into the Mapper and Hierarchical algorithms. The synthesized data from these systems had a clear distinction between the two programs. Although the Hierarchical system binned a few Block Groups, including similar cluster groupings which grew exponentially, it was lacking information in comparison to the Mapper. Specifically the hierarchical cluster forced the majority of the Block Groups into the final cluster, therefore making the entire state a Block Group. Mapper created a more detailed explanation of the redistricting, specifically focusing on non-white, college aged, and low income populations in Cincinnati. Cleveland also registered a high centralization within the college populations. Other groupings registered by Mapper included older generations, wealthy populations, and non-white groupings. In the entirety of Ohio, clusters were formed in both urban and rural areas, highlighting cities specifically. Had more time been allotted, further studies could have been conducted in other regions to provide more data with different parameters.

Board 28

JENNIFER DOUGLAS

Research Mentor: Shala Hankison
Department of Zoology

This past summer I had the opportunity to be an intern with Magellanic penguins at the Jacksonville Zoo in Florida. This internship gave me hands on, interactive learning experience that allowed me to expand my knowledge in the zoological field. I had daily interactions with the twenty-six penguins ranging from newborns to seventeen years old. Also this experience allowed me pass my animal trainer certification exam, allowing me to be able to put together training plans for any species of animal.

PENGUIN KEEPER INTERNSHIP

This past summer I had the opportunity to be an intern with Magellanic penguins at the Jacksonville Zoo in Florida. This internship gave me hands on, interactive learning experience that allowed me to expand my knowledge in the zoological field. I had daily interactions with the twenty-six penguins ranging from newborns to seventeen years old. Magellanic penguin's average lifespan is about twenty five to thirty years and prefer warm weather climate typically found in South America along the coastal regions of Argentina, Chile, the Falkland Islands, and Brazil. My normal daily routine consisted of feeding the penguins three times a day, tracking the exact amount each individual eats, sorting crates of fish to make sure the penguins were eating only high quality fish, preparing daily vitamins and medications, providing enrichment, daily behavioral training, and cleaning exhibits and enclosures to ensure a healthy environment. Also during this experience I had the opportunity to work with other sections of the bird department of the zoo. I had the chance to work with four baby flamingos that needed daily swim time, exercise, and training in order to make sure each of them maintained a happy and healthy lifestyle. Other species I had the opportunity to work with were Roseate Spoonbills, Mandarin Ducks, Boat-billed Herons, Wrinkled and Wreathed Hornbills, Lorikeets, Macaws, Oystercatchers, Inca Terns, and Black Bellied Whistling Ducks, and Aardvarks. The Penguin Keeper Internship at the Jacksonville Zoo allowed me to perform all of the daily routines that a zookeeper would do. This experience allowed me to experience what my field looks like after graduation and taught me many skills on how to handle birds, provide medications, perform daily trainings, and much more.

Board 29

JOSHUA QUEENER

Research Mentor: Christine Thomas
Department of Chemistry and Biochemistry,
The Ohio State University

Chemical processes are at the center of most industrial processes. The compounds that give the best performance are often noble metal based, meaning they include expensive metals like platinum. Our focus was to create new chemical compounds using cheaper metals as the base, that could potentially replace the more expensive compounds.

TI/CO EARLY-LATE HETEROBIMETALLIC COMPLEXES

Bimetallic complexes have been of increasing interest in the literature thanks to their ability to have different reactivities than the analogous monometallic compounds[1]. Hetero-bimetallic complexes have become an area of high interest as the different metal centers can produce a synergistic effect improving catalytic activity. These bimetallic compounds are being studied in search of a catalyst that has reactivity comparable to the noble metals like Pd and Pt. The latter metals are considered some of the best metals for catalysis, but it is expensive and may not offer the selectivity that the bimetallic systems can. Multiple new Ti/Co bimetallic compounds were synthesized. These compounds were compared to similar Zr/Co complexes previously characterized. The compounds were characterized by NMR and X-Ray crystallography. The Ti/Co compounds showed noticeable different reactivity from the Zr/Co system. The compounds will be tested for reactivity with various catalytic substrates. The current results show little to no use in one electron transfer reactions.

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 a variety of professional development topics, including 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 30

COLIN HAWES

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

Most atomic nuclei show very similar behaviors when compared with those of their nearest (in mass) neighbors. However, this is not the case with the arsenic-74 isotope, which shows a very different pattern in its decay energies than other arsenic isotopes when it relaxes from a high rotation rate to a lower one. This study seeks to understand why it might be different by probing its shape through a measurement of its decay times.

LIFETIME MEASUREMENTS IN ^{74}AS

Most odd-odd arsenic (As) isotopes share a characteristic oscillating pattern in the energy differences between adjacent states in their positive-parity bands, with the even (odd) spin states lying relatively higher (lower) in energy than the odd (even) ones at high spin. An exception is ^{74}As, which shows a phase in the pattern that is exactly opposite to the established trend. A recent study suggested that this irregular pattern results from an underlying triaxial shape with a particular degree of deformation. Lifetime measurements could be used as an independent check of this assertion since deformations can be inferred from them. However, so far lifetimes of high-spin states have not been measured in ^{74}As. Thus the goal of this work was to measure as many lifetimes as possible in ^{74}As using the Doppler-shift attenuation method in order to test the existing interpretation of its positive-parity structure. High-spin states in ^{74}As were populated using the ^{14}C(^{62}Ni, *pn*) reaction at 50 MeV performed at Florida State University. Gamma decays were measured in coincidence using a Compton-suppressed array of 3 Clover detectors and 7 single-crystal detectors. Three lifetimes were measured within the positive-parity band and used to infer the quadrupole deformation parameter β_2 as a function of spin. The experimental β_2 values were then compared with theoretical ones extracted from total Routhian surface (TRS) calculations. Although the magnitudes of two experimental values are in good agreement with the corresponding theoretical ones, the general trend of the experimental deformations with spin are not reproduced by the TRS calculations. However, triaxial shapes appear to be favored at high spin.

Board 31

GRACE KLAUSEN

UNIVERSITY OF MISSOURI-KANSAS CITY

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

It is common for atomic nuclei to possess deformed (non-spherical) shapes. Sometimes the deformation leads to a unique signature of radioactive decays, acting somewhat like a "fingerprint" of the underlying structure. In the arsenic (As) isotopes (having 33 protons), strong deformation in As-71 (having 38 neutrons) results in an unusual sequence of decays that has not been observed in As-73 (having 40 neutrons). This work attempted to understand why the unusual decay pattern exists in As-71 but not in As-73.

LIFETIME MEASUREMENTS IN ^{73}AS

Only two nuclei in the mass A = 70 region (^{67}Cu and ^{71}As) are known to exhibit large deformation as a result of a proton occupying the $f_{7/2}$ orbital. So far, the experimental signature of such an occupation has not been found in ^{73}As. Thus the goal of this work was to infer the underlying deformation of ^{73}As by measuring as many lifetimes as possible in an attempt to understand the lack of such a structure in this nucleus. ^{73}As nuclei were produced at high spin using the ^{14}C(^{62}Ni, *p2n*) reaction performed at Florida State University with a beam energy of 50 MeV. A Compton-suppressed Ge detector array consisting of three Clover detectors and seven single-crystal detectors was used to record γ rays in coincidence. Lifetimes of 14 excited states were measured using the Doppler-shift attenuation method, which compares the slowing-down time of ^{73}As nuclei in the target with the decay time of each state of interest. Whenever possible, mean lifetimes were measured by gating from above the transition of interest to eliminate the dependence on unknown side feeding. Quadrupole deformation parameters β2 were inferred from the lifetimes assuming axially-symmetric shapes and compared directly with those from total Routhian surface (TRS) calculations. The trend of the experimental β2 values with spin showed better agreement with the predicted ones for the positive-parity states than the negative-parity states.

Board 31

JACOB TARNOWSKI
ST. JOHN FISHER COLLEGE

Research Mentor: Scott Linder
Department of Mathematics and Computer Science

In many industrial or clinical settings, subjects in experiments are *time censored* — that is, the experiment ends at a particular time and any events that have not occurred by that time are not observed. In these settings, the traditional inferential statistical methods applied to complete samples containing independent observations are not appropriate because censoring impacts the sampling distributions of associated statistics. In this work we examine the impact of time censoring (Type 1 censoring) on the sampling distribution of the sample correlation coefficient, and we propose a simple method for approximating it. This approximation allows for more appropriate inference about the correlation between two variables in such a setting.

APPROXIMATE SAMPLING DISTRIBUTION OF SAMPLE CORRELATION COEFFICIENT UNDER TYPE I CENSORING

Suppose a random sample of size n is selected from a bivariate normal population and exposed to Type I (time constrained) censoring on one of the variates, so that cases associated with the values of one of the variates beyond time T are censored. The presence of censoring in this context renders intractable the sampling distribution of the sample correlation coefficient. Using simulation, we systematically examine the impact of censoring on the sampling distribution of the absolute correlation coefficient, $|r|$. We propose approximation of the sampling distribution of this statistic by the Beta distribution, whose parameters are determined as functions of the experimental conditions (n, proportion censored (θ), and ρ). These functions are regression models fit to the average maximum likelihood parameter estimates obtained through simulation. We examine the goodness-of-fit of this approximate sampling distribution, and also consider the relative error of estimation of percentiles of this distribution commonly necessary for inference.

MATHILDE ROSI-MARSHALL
UNIVERSITY OF VIRGINIA

Research Mentor: Craig Jackson
Department of Mathematics and Computer Science

In the Earth climate system there are a number of important feedback processes, which are geophysical sub-systems of the climate that act to amplify or dampen the temperature change in response to forcing (for example, an increase in atmospheric carbon dioxide). Two feedback processes of interest are the ice albedo and water vapor feedbacks, which are both positive feedbacks, meaning they tend to amplify the change in surface temperature response to forcing. Our project investigates a new method of quantifying the effects of climate feedback processes, as opposed to the standard approach, which derives single numerical values that quantify the overall global or local effects of a feedback process. In our study, we seek to validate a new matrix-based method of feedback analysis using ideas proposed by V. Alexeev and C. Jackson, which is independent of the applied forcing, accounts for both the local and non-local effects of a feedback process, preserves most nice properties of the standard method, and which can lead to new insights for understanding both the local and non-local effects of climate feedback processes.

AN EVALUATION OF A MATRIX-BASED FEEDBACK ANALYSIS IN A GLOBALLY RESOLVED ENERGY BALANCE MODEL

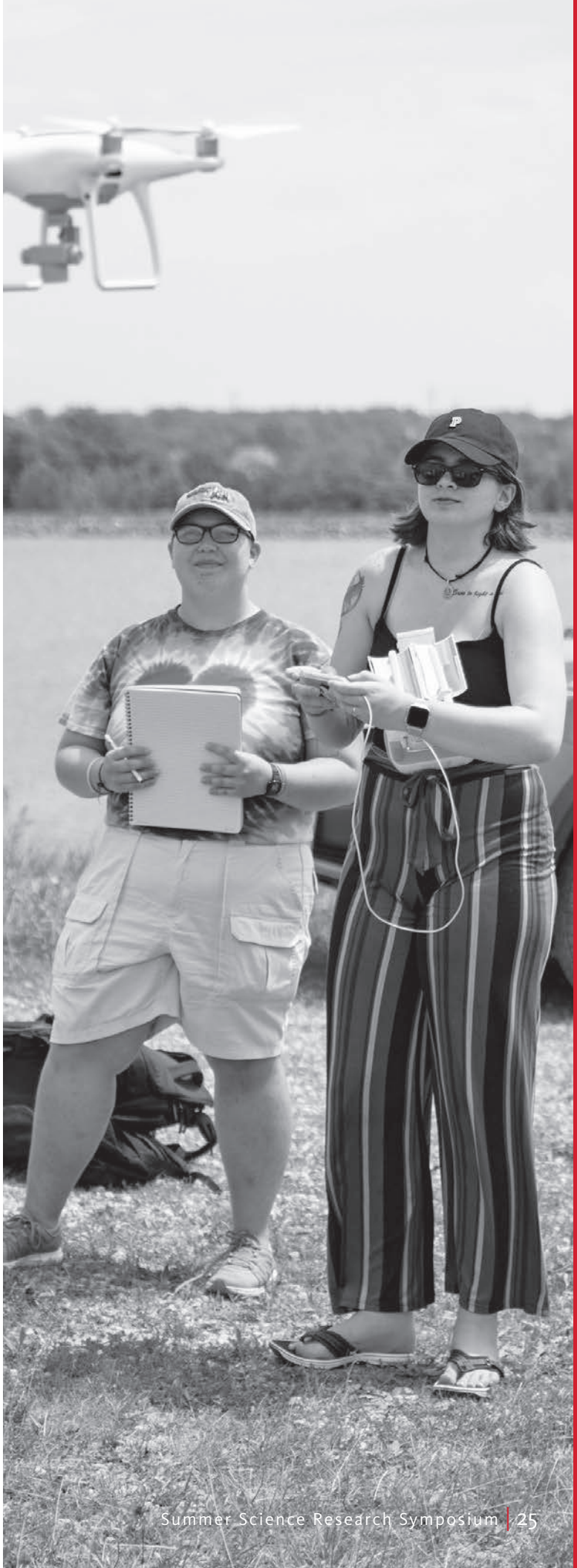
Typically, a formal feedback analysis of climate processes produces numerical values, called feedback factors, which quantify the global or local effect of a feedback process. These are derived from a comparison of the equilibrium surface temperature responses to an applied forcing, with and without the feedback process active. However, these feedback factors are sensitive to the shape of the applied forcing. In this study, we investigate a newer, matrix-based approach to feedback analysis using ideas proposed by V. Alexeev and C. Jackson, which allows for a forcing-independent representation of a feedback's local and non-local effects. We test the validity of this new approach, using it to analyze ice albedo and water vapor feedbacks within a globally resolved energy balance model developed by D. Dommenget and J. Flöter. We demonstrate that feedback matrices fully generalize standard feedback factors, in that the latter can be derived from the former, while retaining several standard identities, including the additivity of feedback factors. Finally, we discuss the ways in which this matrix-based approach provides new insights for understanding both the local and non-local effects of climate feedback processes by encoding the extent to which non-local changes in surface temperature are integrated by the feedback process to shape the local temperature anomaly.

WILLIAM ELLIMAN

Research Mentor: Sean McCulloch
Department of Mathematics and
Computer Science

AI FOR THE CARD GAME MODERN ART

AI for games like Modern Art is more complicated than older and more well known ones. Modern Art, in a way, is similar to poker, the players do not know all of the information about the state of the game. They need to either make guesses about what the other players have or make even more general judgments about the information that they can see. This game in particular has an extra layer of complexity, the players need to make multiple types of moves. The moves can be playing a card or bidding on one. The goal of this research project was to find a strategy for an AI to use to win the game. Many different strategies were implemented and the AIs played tournaments in order to see which ones were better than others. After the tournaments were completed the following was found to be the best strategy, although improvements could still be made for more specific cases. At the beginning of a season the AI should focus on trying to win auctions. After it has won a few it should lock in an order that it wants to see the artists in at the end of the season. The order coming from how many of each artist it has won. This order should then be used to determine how much the player should bid and what cards the player should play.



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

Katie Vonderembse
Graduate school at Miami University (Oxford, OH) for a Masters of Environmental Science focusing in Applied Ecology

Landry Cowles
Completed an internship at the Mayo clinic under Dr. Timothy Nelson (OWU alum)

Colin Hawes
REU at Ohio Wesleyan with Bob Haring-Kaye

Michael Heeschen
Spent summer in southern Germany

MaLia Walker
Post baccalaureate program at UCLA for a year and preparing for the MCAT

Serena George
Veterinary school at University of Wisconsin

Callie Angelo
Summer 2019: In Ireland studying the history and political troubles throughout Northern Ireland and the Republic. Fall semester 2019 abroad: Geneva, Switzerland studying Global Health and Development Policy to study the sociocultural factors which lead to a significantly gendered death rate in Switzerland

Maddie Meyer
REU position at University of Utah's Chemistry mentor Dr. Burrows

Aidan Shumaker
Working at Food Safety Net Services in Columbus, OH in food microbiology

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	Mentor	Department	Title
Kelly Coffyn	Amy McClure	Education	Naomi's Village Research Proposal—A Comparison of Early Childhood Education in Nairobi Kenya to America: Pedagogical and Literacy Practices
Joseph Emerson	Brad Trees	Physics and Astronomy	Effects of network structure and alterations in full-brain epilepsy model
Sarah Mattick	Franchesca Nestor	Politics and Government	Campus Climate as Perceived by Conservative Leaning Students
Diego Venegas Vargas	Robert Haring-Kaye	Physics and Astronomy	High-Spin states in the ^{70}Ga Nucleus
Kathleen Vonderembse	Amy Downing	Zoology	Response of plankton communities to chloride from road de-icing

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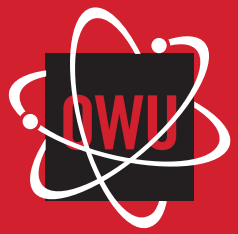
Faculty supervisors and student volunteers
Parents and guardians of student researchers



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