Patricia Belt Conrades

October 6, 2022

Summer Science Research Symposium

Ohio Wesleyan University

PRINCETON VAUGHN

OWU ’22, SSRP ’20 | CURRENTLY A PH.D. STUDENT AT PRINCETON UNIVERSITY

“Ohio Wesleyan’s Summer Science Research Program introduced me to the reality of conducting scientific research. Working closely with a professor, I learned that, in truth, research is hard, but very rewarding work. I really enjoyed my experience though, so much so that it encouraged me to get my Ph.D.”

THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM

The crises that are upending our world — from the lasting dilemma of the COVID-19 pandemic to the long-term existential threat of global climate change — have boldly reminded us of our reliance on science, mathematics, and technology. We turn to scientists and their research to help us understand and solve such global challenges.

Now in its 30th year at Ohio Wesleyan, the Summer Science Research Program, which culminates in the Patricia Belt Conrades Summer Science Research Symposium, prepares OWU students for careers in science research. The program provides an intensive 10-week opportunity for students to tackle complex research issues by working with seasoned, accomplished mentors at OWU and other universities across the country. Students prepare poster displays highlighting their research results for the Symposium event. Please ask the students any questions you wish; they are proud and excited to tell you what they learned and why it matters. After the event, research will be posted at **owu.edu/ssrp2022**.

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October 6, 2022 | 1-3 p.m.

The Patricia Belt Conrades Summer Science Research Symposium coincides with Ohio Wesleyan's inaugural Connection Conference.

owu.edu/ssrp
owu.edu/ConnectionConference

THE MAKING OF A SCIENTIST

While so many things have changed recently, one thing that remains a constant is that the talented science students at Ohio Wesleyan continue to make meaningful contributions to scientific research along with their faculty mentors in the OWU Summer Science Research Program (SSRP).

This summer, students had the opportunity to work with OWU faculty mentor here on campus. Authentic research is quite different from classroom labs — more challenging, more creative, more frustrating, and, ultimately, more rewarding.

One of the most rewarding parts of SSRP for me 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 22 students who performed research at OWU mentored by OWU faculty members and 22 additional OWU students who performed research off campus at other universities. 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.

Be brave! Ask a question! Our research students are eager to interact with you and answer your questions about their work. They are looking forward to interacting with their audience!

So on behalf of the 44 OWU students and 9 OWU faculty mentors whose research will be featured today in the Symposium, thank you for attending. Your presence is greatly appreciated.

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

Laura Tuhela-Reuning
Department of Biological Sciences
Scanning Electron Microscopist
Summer Science Research Program Director

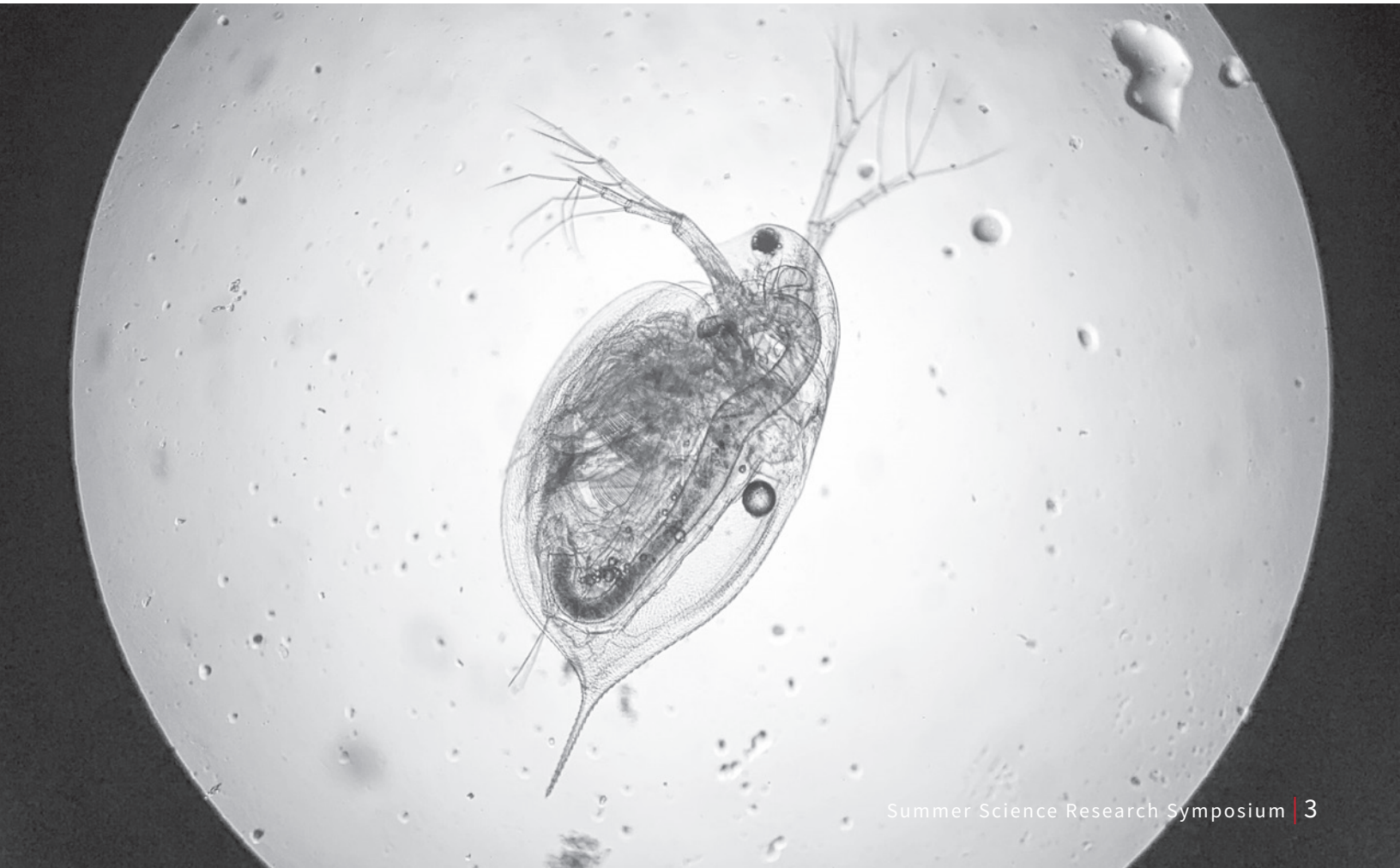



THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM ENDOWMENT

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, Carolyn “Pat” 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.

Pat, who passed in December 2021, was a long-time and generous supporter of Ohio Wesleyan’s Summer Science Research Program. She visited campus several times during the summer months to meet with students and faculty conducting research.

Pat earned her B.A. in psychology from Ohio Wesleyan University in 1953. She worked for the Case Western Reserve University School of Medicine and the Cleveland Hearing and Speech center before spending more than 25 years as the administrator of the Case Western Reserve University School of Law retiring in 1992.

Pat he had vivid memories from childhood of her father helping those less fortunate. “He always made sure that if someone was in trouble and he could help, he would do it,” said Pat. "My father was a straight arrow, and he was very generous. He was just that kind of person." Pat and her parents created the Ferry Family Endowment with the hope of contributing some of their wealth to education. When the time came to begin distributing funds, Ohio Wesleyan was at the top of Pat's list. She was a member of Tower Society after committing to include OWU in her estate plans.

“I am pleased to have graduated from Ohio Wesleyan and to have been a part of doing something that might help the school in some way,” Pat said. “It's just part of the giving back. I believe in this.”




Board 1

ERIN POHLMAN

Research Mentor: Kayce Tomcho
Department of Chemistry

Proteins play an important role in our bodies which have parts with certain functions linked to their appearance; their structure. Like baking a cake, each ingredient has a specific function to yield the best result. If you incorrectly add or omit an ingredient then the cake won't look right, and a baker needs to know what caused the problem. The glycine receptor (GlyR) can lead to different illness if a mutation to the receptor occurs. Our study focuses on a certain piece of the receptor to better understand how that particular "ingredient" impacts its appearance — its structure — which gives more insight into its function and therefore, illnesses linked to the receptor can be better treated.

CHARACTERIZING THE M3-M4 LOOP OF THE GLYCINE RECEPTORS POTENTIAL TO TRANSVERSE THE MEMBRANE

The glycine receptor (GlyR) is part of a family of pentameric ligand-gated ion channels (pLGICs) that allows chloride ion influx which hyperpolarizes the cell. A recent study by Tomcho et al. using crosslinking mass spectrometry and single, systematic cysteine mutations in resting, open and desensitized states, indicated that the intracellular M3-M4 loop of GlyR is dynamic, which is consistent with previous literature findings. This study also suggests the ability of the loop to transverse the membrane similar to cell penetrating peptides (CPPs). CPPs are peptides that facilitate cellular intake and uptake by passing through the membrane and consist of basic or amphipathic chains of 5-30 amino acids. The M3-M4 loop is rich in lysine and arginine residues and thus, resembles the sequences of CPPs found in vivo. This study aims to characterize the interactions between the M3-M4 loop and a native-like membrane bilayer, both as truncated segments and as the whole nearly 70 residues in the loop. Advancing the understanding of the structure-function relationship is essential to improving therapeutics to treat conditions linked to GlyR.

Board 2

ABBY BIDDLE

Research Mentor: Chelsea Vadnie
Department of Psychology;
Neuroscience Program

Mental health disorders, such as depression and anxiety, often begin when people are in their mid 20s. Adolescence is the period right before the onset of these disorders, however, there is little research done on how events during this time affect mental health in comparison to adult or postnatal studies. Our study uses stress in juvenile mice to see if this time period is critical in causing depressive- and anxiety-like behaviors in adulthood.

DETERMINING THE EFFECTS OF ADOLESCENT STRESS ON PSYCHIATRIC-RELATED BEHAVIORS OF ADULT MICE

Anxiety and mood disorders are highly prevalent and commonly diagnosed in late adolescence through early adulthood. Stress is a major risk factor in the development of these mental health disorders, but little is known about the effects of stress during adolescence. In this study, we investigated how stress during the period of early adolescence, postnatal days 25-27, affects early adulthood behavior and biological measures in C57BL/6J mice. The mice were separated into stressed and unstressed groups. The stressed mice experienced forced swim, restraint, and elevated platform stressors, while the unstressed group was left untouched during the stressor period. Both groups were then left undisturbed until postnatal day 60 when they were tested to see if stress during adolescence would cause an increase in anxiety and depressive-like behaviors in adulthood. The open field and the elevated plus maze were used to test anxiety-like behavior. We used the tail suspension test and the sucrose preference test to assess depressive-like behavior, and the y-maze to test spatial working memory. Blood and brain tissue were collected approximately 72 hours after the end of the testing period to study the effects of adolescent stress on adult corticosterone levels and gene expression in the brain. The results of behavioral testing will be presented at the Fall 2022 Student Symposium.

Board 3

JOSH CABACUNGAN
LINDSEY ASHCRAFT

Research Mentor: Chris Wolverton
Department of Biological Sciences

In previous studies in Dr. Wolverton's lab, 124 genes were identified as potentially being involved in plant gravity response in *Arabidopsis thaliana*. Many of the genes identified are not related and code for a wide variety of functions within plants. One of these genes, UMAMIT 17, was identified to be a regulator of gravity. This gene is believed to also be a growth regulator within plants; this gene, along with the rest of the family of genes is further being studied to determine their impact on the regulation of growth in *A. thaliana.*

GROWTH REGULATOR GENE FAMILY IN *ARABIDOPSIS THALIANA*

The UMAMIT (usually multiple acids move in and out of transporters) gene family contains many genes that also are related to transmembrane transporter activity, which can regulate plant growth. In previous gravitropism research in Dr. Wolverton's lab, one of these UMAMIT genes in *Arabidopsis thaliana*, AT4G08300 (UMAMIT 17), was identified as one of 124 genes that may be involved in the gravity response pathway. Previous experiments of mutant seedlings lacking gene AT4G08300 included rotating the 4 day old seedlings 90 degrees then allowing them to grow for 200 minutes and taking pictures every 10 minutes. These mutants were proven to have a faster response to gravity than wild-type plants. After analysis of these initial experiments, the mutant also was determined to grow faster than the wild-type plants, though confounding factors prevented absolute measurements. To get more accurate measurements than the original experiments, experiments were conducted again using known distances to more accurately measure the plants. The rotation experiments were conducted again, as well as experiments letting plants grow vertically to see if the observed growth difference was due to rotation. Multiple mutants lacking genes that are the most phylogenetically related to AT4G0830 were also ordered to better understand the UMAMIT family.

Board 4

ETHAN LIVINGSTON

Research Mentor: Eric Gangloff
Department of Biological Sciences

In this project we examined sandfish skinks, which are lizards that swim through sand, and measured preferred temperature and the effect of temperature on their performance. First, we measured the preferred temperature of lizards during the day when they were given a choice of a broad range of temperatures. Second, we measured how quickly skinks submerged themselves in sand and how fast they could sprint at different body temperatures. This project has given us a better understanding of how desert specialists select body temperatures and how temperature affects their ability to complete important tasks.

THE IMPORTANCE OF TEMPERATURE IN *SCINCUS SCINCUS*, THE SAND-SWIMMING SKINK

Little is known about the natural history of the sandfish skink *(Scincus scincus)*, despite its range spanning two continents and being common in the pet trade. In arid and hot environments across North Africa and the Arabian Peninsula, these lizards spend up to 90% of their day beneath sand and are uniquely adapted to this environment. However, much about the basic biology of this species remains unknown, especially in regard to its adaptations to its thermal environment. To better understand how the sandfish skink thermoregulates, we studied their thermal preferences and their use of sand horizons as a method for body temperature regulation. We monitored individual lizard body temperatures throughout the day in an environment where they had the ability to pick their ideal temperature. Additionally, we quantified the thermal dependence of performance by recording sprinting speed and diving speed, important for prey capture and predator avoidance, across a range of temperatures. We then tested the hypothesis that thermal preferences and the optimal temperature for diving and sprinting performance are correlated, suggesting co-adaptation of behavior and physiology. Overall, these data provide understanding of how this unique ectotherm survives in the extreme thermal conditions of a scorching hot desert.

Board 5

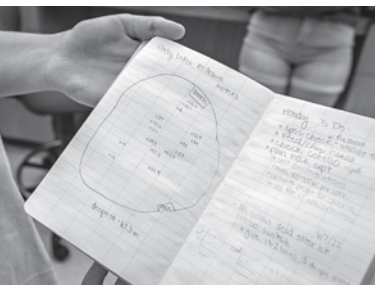
MAKENNA JUERGENS
ABIGAIL DOZA

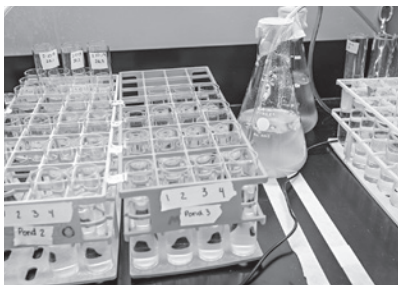
Research Mentor: Amy Downing
Department of Biological Sciences

Environmental policies are designed to protect natural ecosystems and humans that depend on them. Researchers are exploring if the EPA legal limit of salt allowed in freshwater ecosystems due to road de-icing is sufficient to protect freshwater ecosystem quality. Previous studies have shown that Daphnia, an ecologically important freshwater invertebrate, may be sensitive to salt concentrations lower than the EPA legal limit. Our study focuses on finding the maximum livable salt concentration for the species *Daphnia pulicaria.*

EXPLORING LOCAL AND REGIONAL VARIATION IN NACL TOLERANCE IN *DAPHNIA PULICARIA*

Anthropogenic activity has adverse effects on freshwater ecosystems. For example, road deicing adds excess salt (NaCl) into the water, a known detriment to freshwater organisms. Freshwater ecosystem health is largely indicated by the invertebrate species Daphnia — an important bioindicator and integral part of the food web. Previous studies have found that the lethal concentration of NaCl at which 50% of the Daphnia population dies (LC50) occurs between 900 and 2,000 mgCl/L in lab conditions. In order to determine underlying factors contributing to this LC50 range, we are collaborating with labs globally to observe the variation of Daphnia salt tolerance on local, regional, and global scales. In this study we studied the NaCl tolerance of local *Daphnia pulicaria* populations sampled from three lakes in Madison County, OH (Prairie Oaks Metro Park; Darby Lakes Residences). Our results suggest that the LC50 for our systems occurs between 900 and 1,200 mgCl/L and that there does not appear to be substantial variation between family lines within the same pond, but there is evidence of slight variation between populations in different ponds. These results will be compared with those of labs participating in the study to determine global variation in Daphnia salt tolerance and to explore factors that might determine salt tolerance, such as previous exposure to salt in native ponds, local environment conditions, and genetics. This study will help us understand to what degree anthropogenic activity impacts freshwater ecosystems as well as improve environmental policy and EPA guidelines on how much salt can be used for winter road maintenance.





Board 6

CHANDLER CARR

Research Mentor: Dustin Reichard
Department of Biological Sciences

House Wrens are a common backyard songbird that build nests in cavities they find. Rather than all nests being roughly the same, the structure of the nests are very different between wren pairs and we do not understand why. To help answer this question, we measured differences in nest structure between nesting attempts and tested whether female House Wrens, the primary creators of nests, build their nests consistently from clutch to clutch. We believe that since the primary cause of variation in nest building is the female that builds them, we will find little connection between nest structure and whether a nest is successful or not.

NEST BUILDING BEHAVIOR AND ARCHITECTURE IN HOUSE WRENS *(TROGLODYTES AEDON)*

Nest architecture is one of the primary factors that determines the survival of nestling songbirds. The location, structure, size, and materials used are all important for protecting young from the surrounding environment. However, in House Wrens *(Troglodytes aedon)* past research that tried to relate nest structure to fitness largely yielded null results. Furthermore, nest architecture, such as height, is highly variable within and among populations, potentially suggesting minimal selection on nest architecture for offspring fitness. We explored how different nest characteristics such as nest height, distance between the cup and the entrance, and the number of feathers correlated with proxies for offspring fitness like parasitic load and the number of offspring fledged. We hypothesized that, in the absence of selective pressure, female House Wrens, the primary architect of nests, build their nests based on individual preferences. Therefore, the building female will be a stronger predictor for nest variation than proxies of offspring fitness.

Board 7

ALYSSA HEAD

Research Mentor: Eric Gangloff
Department of Biological Sciences

The size and shape of animals' body parts are important for how they perform essential tasks in their environment. To test the hypothesis that the shape and size of various body parts vary among populations in the common wall lizard, we measured body dimensions in male and female lizards, including head, limbs, toes, tail, shoulder girdle, and pelvic girdle. We then tested whether the body dimensions differ between the sexes and among populations in Ohio, USA and France with very different ecological histories.

LET'S INCLUDE THE LADIES: BODY DIMENSIONS IN THE COMMON WALL LIZARD ACROSS POPULATIONS WITH VARYING ESTABLISHMENT HISTORIES

The size and shape of animals' body parts are important for how they perform essential tasks in their environment. Additionally, body morphology can change and adapt over time depending on habitat structure and can therefore vary across populations within a species. Changes in lizard body shape have yet to be characterized across populations with varying establishment histories in the common wall lizard *(Podarcis muralis)*, a successful global colonizer. Further, most conclusions about variation in lizard morphology have been based on only males, leaving many unanswered questions about the female sex. Female common wall lizards are essential to include in studies because they are the limiting factor in reproduction and population establishment. Therefore, they experience selective pressures not only for survival but also for reproduction. To address this knowledge gap, we measured various body dimensions in male and female lizards, including head size, limb segments, toes, tail, shoulder girdle, and pelvic girdle. We compared lizards from invasive populations with different establishment histories in Ohio, USA (Cincinnati, where lizards have been established for over 70 years, and Columbus, a recently-established population) and native populations from both low-elevation and high-elevation mountain habitats in France. After standardizing to body size, we used multivariate statistical tools to test the hypothesis that morphology varies among these populations and to quantify differences between males and females. This study thus provides insights into how vertebrates may adapt to novel environments and how selective pressures might shape males and females differently.

Board 8

NANDINI ARORA
LINDSEY ASHCRAFT
JOSH CABACUNGAN
NICOLE KLABUS
CARLY SANDERS
ABBEY SETLIK
REECE TROWBRIDGE

Research Mentor: Chris Wolverton
Department of Biological Sciences

Before plants are able to use nitrogen, an essential nutrient, they must first change its form. Two genes in *Arabidopsis thaliana* are known to be key players in the first steps of this process but are also thought to be involved in an alternative gravity response pathway. By using plants that are confirmed to have a non-working copy of these genes, it can be determined if and how these genes are interacting with gravity. These results can be used to understand how plants respond to gravity, which will contribute to the ability to grow plants in environments with lesser gravity, such as in space.

USING GENETICS TO DETERMINE THE COMPONENTS OF GRAVITY SENSING IN *ARABIDOPSIS THALIANA*

Gravity is the most persistent influence on plant growth, architecture, and the way plants respond to their environment. Amyloplasts, starch-filled structures within plant cells, are known to be the preeminent factor in plant gravity sensing. Research has shown that mutant *Arabidopsis thaliana* plants lacking amyloplasts use alternative means of responding to gravity. Previous work in our lab comparing early transcriptional changes between wild-type and starchless roots following gravistimulation identified 124 genes of interest in the gravity response pathway. Mutant seedlings containing a T-DNA insert that disrupts the working copy of the gene of interest were cultivated for experimental use. To collect more data and narrow the list of 124 genes, DNA and RNA were isolated from the plant tissues and amplified using PCR methods. Using gel electrophoresis, the PCR products were confirmed to be consistent with a plant lacking the specific gene of interest. Arabidopsis seedlings confirmed via gel electrophoresis were then run through a series of imaging tests. The first test consisted of rotating five seedlings precisely 90 degrees; a picture was taken every 10 minutes for a 200-minute period where the plants were allowed to grow. Angle measurements were recorded at determined intervals. The second test included rotating seedlings 90 degrees, then 15 degrees every hour for 200 minutes. Pictures were taken every 10 minutes, and angle measurements were recorded at specific intervals. The research conducted is ongoing and therefore incomplete. The conclusion of these experiments will narrow down the list of genes involved in gravity response and allow a better understanding of the components involved in an alternate gravity response pathway.

Board 9

ZOË SWANSON

Research Mentor: Dustin Reichard
Department of Biological Sciences

Humans have distinct personalities that allow us to predict how someone will react to a new situation. Do other animals also have personalities and behave in predictable ways? Our study examines this question by presenting house wrens, a small songbird, with a fake predator and a novel object that they have never seen before, to test their aggression and boldness. Much like in humans, we predict that a more aggressive wren in response to the predator should be bolder in response to the strange object. Such similarities between the wren's reactions, would support a personality.

DO FEMALE HOUSE WRENS *(TROGLODYTES AEDON)* HAVE PERSONALITIES?

Personalities that result in consistent, individual differences in behavior are not restricted to humans, but instead extend across the animal kingdom. We tested whether house wrens *(Troglodytes aedon)*, a cavity-nesting songbird, exhibit personalities by measuring their aggressive response to a model of a common nest predator, the black rat snake *(Pantherophis alleghaniensis)*, and their boldness in response to a novel object that the female wrens have never encountered. Each stimulus was placed on top of the nest box for seven minutes and the behavior of the female was recorded. We predicted that if house wrens have personalities, a more aggressive response to a nest predator will correlate with a bolder response to a novel object at the nest box. We found that aggressive and bold behaviors had a positive correlation, which is consistent with our hypothesis that house wrens have personalities just like other animals across the taxonomic spectrum.

Board 10

BRYAN BENAVENTE

Research Mentor: Nick Dietrich
Department of Math and Computer Science

Our study investigates how the public forms opinions on US foreign policy. We asked people to read made-up news stories about US foreign affairs and share whether they approved of the actions taken by our government. The results of our research show that the public is less likely to support the foreign policy decisions of a president from an opposing political party. We also find that the public is less likely to support foreign policy when they feel that the decision could be costly to the US.

PARTISANSHIP & PUBLIC OPINION ON INTERNATIONAL HOSTILITY

What factors shape public opinion on foreign policy responses to international hostility? The US government has employed tactics such as condemnation, economic sanctions, provision of military aid to other actors, and direct use of military force to respond to global conflicts. The public takes partisan identity and perception of costs into consideration when determining their support for these actions. We use a survey experiment to randomly vary the partisanship of the president making foreign policy decisions as well as the involvement of state or non-state actors in the conflict. We find strong evidence that the public is less likely to support the decisions of an opposite-party president in all foreign policy responses that we test. The public is also responsive to costs, supporting war at a lower rate than other interventions. We find limited evidence that the public is likely to support alternatives to direct confrontation against state actors as opposed to non-state actors. Public opinion on international hostility is shaped by partisanship and the perceived domestic costs of intervention.

Board 11

KYLEIGH BECK
JAMES DOERLE

Research Mentor: Bob Harmon
Department of Physics and Astronomy

Sunspots are cooler and darker regions on the surface of the Sun that are caused by magnetic fields. When sunspots occur on other stars, they are called starspots. We are studying how starspots on a Sun-like star named LO Pegasi change over time. This is done by using a telescope at Perkins Observatory to measure how LO Pegasi's brightness changes as it rotates and its spots come into and out of view. We then use Light-curve Inversion (LI), a program developed by Dr. Harmon, to map the starspots of LO Pegasi based on the measurements of brightness we obtain.

IMAGING STARSPOTS ON LO PEGASI VIA LIGHT-CURVE INVERSION

LO Pegasi is a spectral-type K8, main-sequence, variable star located 81 lightyears from Earth in the constellation Pegasus. The variation in its brightness is due to the presence of large starspots on its surface (analogous to sunspots on the Sun). Starspots are cooler, darker regions on the surface of a star that are caused when strong magnetic fields prevent convection in the star's outer layers. As LO Pegasi rotates and its spots come into view, it appears darker. As the rotation carries the spots out of view, the star appears brighter. LO Pegasi has a rotational period of 10.153 hours. In comparison, the Sun's rotational period is approximately 27 days. LO Pegasi's quick rotation rate causes it to be highly magnetically active. As a result, LO Pegasi's surface features an ever-present polar spot in addition to mid-latitude starspots. In order to obtain data, a CCD camera was used to take digital images through standard B, V, R, and I photometric filters at Perkins Observatory over a series of nights in June and July. Aperture photometry was performed on the images to obtain LO Pegasi's brightness relative to a set of comparison stars as it rotated. The resulting data was plotted to create light curves and fed into a program called Light-curve Inversion (LI) that created maps of LO Pegasi's surface. We present these maps in comparison to previous data from 2014-2021.

Board 12

AADARSHA GOPALA REDDY

Research Mentor: Sean McCulloch
Department of Mathematics and Computer Science

Automated agents have been developed for card and board games for decades. My research similarly involves creating a digital version of the card game Lost Cities and implementing an automated agent to play against. My goal is to improve the agent to a level where it can do better than a human at the game.

ARTIFICIAL INTELLIGENCE IN MODERN BOARD GAMES

Lost Cities is a two-player card game which takes about 10 minutes to play. It involves the players placing or discarding wager cards and expedition cards in some of the five columns/expeditions. Each expedition where a card has been placed has an initial cost. At the end of the game, when there are no cards available to draw from the undealt cards, the total points minus the cost of starting the expedition times the wagers are added up from each expedition. Whichever player has the highest total is the winner. I developed a program using Java that implemented these rules and perfectly works for human vs. human games. I also developed an intelligent agent for a human to play the game against. The methodology behind the agent is to estimate the final score for both players. The estimate uses the probabilities of drawing cards from both the undealt cards and the discarded cards to form an expected score for each expedition. This estimate is calculated for each action available to the agent. The action that creates the best estimated score over the opponent's would be played. We also added calculations to determine the best available card drawing action. We plan to test this methodology against human players and expect to improve upon this design in future summers.

Board 13

CARLY SANDERS

Research Mentor: Chris Wolverton
Department of Biological Sciences

Before plants are able to use nitrogen, an essential nutrient, they must first change its form. Two genes in *Arabidopsis thaliana* are known to be key players in the first steps of this process but are also thought to be involved in an alternative gravity response pathway. By using plants that are confirmed to have a non-working copy of these genes, it can be determined if and how these genes are interacting with gravity. These results can be used to understand how plants respond to gravity, which will contribute to the ability to grow plants in environments with lesser gravity, such as in space.

THE INFLUENCE OF NITRATE REDUCTASES ON GRAVITATIONAL RESPONSE IN *ARABIDOPSIS THALIANA*

Nitrate reductase is an enzyme that plays an important role in nitrogen assimilation. It also provides a source of nitric oxide, which helps plants regulate growth and respond to stress. In *Arabidopsis thaliana*, two nitrate reductase genes, NIA1 and NIA2, are also believed to be involved in the plant's response to gravity. Both genes show gravity-dependent changes in transcript abundance as measured by RNA-seq analysis of the early-stage gravity response in root tips. In order to determine if and how these genes play a role in the gravity sensing pathway, mutant seeds with specific T-DNA inserts were used to disrupt the working copy of the gene of interest. Each mutant line of seeds was confirmed to contain its T-DNA insert through PCR based on DNA isolated from corresponding mutant *Arabidopsis* seedlings. Gravity response experiments were performed to determine whether there was a difference in phenotype between the mutant seedlings and the wild-type seedlings. The results of this research are yet to be determined. In addition, further research is needed to determine in what way nitrate reductase and nitric oxide are specifically involved in the gravitational response.

Board 14

AUDREY CALVIN

Research Mentor: Kayce Tomcho
Department of Chemistry

A multitude of cars exist on the market which vary in capability. To the average buyer, an engine looks similar between car brands, but a mechanic understands that the intricacies of the engine are related to its performance. The proteins of our body work similarly. When structures vary between proteins, their differences ultimately lead to a distinct function. Our research examines the structure of the intracellular M3-M4 loop of one type of protein, the Glycine Receptor (GlyR). By understanding the function of GlyR, we can build more specific tools to treat diseases linked to this protein; in the same way a specific car would require a specific tool to fix it.

INVESTIGATING THE POTENTIAL OF THE M3-M4 LOOP OF THE GLYCINE RECEPTOR TO ACT AS A CELL PENETRATING PEPTIDE

Our cells contain a vast number of proteins that perform countless functions. For every different function, a specific structure coincides. To date, many techniques are used to reveal protein structures including x-ray diffraction and cryo-electron microscopy. These approaches have disadvantages as they are often expensive and require samples of high purity and stability. One method, cross-linking mass spectrometry (CX-MS) has proved advantageous. With CX-MS, a cross-linker is covalently bonded to a known mutation in a protein, and another inter or intra-cellular bond is formed nearby. These distance constraints are analyzed using mass spectrometry which can help elucidate existing structural models. The structure and dynamics of the glycine receptor (GlyR) has been extensively studied using multiple techniques, however; the structure of the intracellular M3-M4 loop remains unclear. Previous CX-MS studies (Tomcho et al.) have shown distance measurements that suggest the loop is very dynamic and may be able to penetrate the membrane and interact with the extracellular domain. Our study has designed a workflow to better understand this mechanism. We hypothesize that the loop is traversing the membrane in a similar fashion as a cell-penetrating peptide (CPP). CPPs are short peptides that cross over the cell's membrane and often contain basic residues such as arginine and lysine. Our experimental design attempts to interact portions of the loop with the cell membrane using co-sedimentation techniques for analysis. Further defining the structure of GlyR may lead to developing targeted therapeutics for its associated diseases.




Board 15

ZYNNIA PETERSON

Macaw Recovery Network

Over the summer I spent a month at a breed and release facility for Scarlet and Great Green Macaws in Costa Rica. I participated in nutrition management, aviary cleaning, chick checkups, enrichment maintinence, and necropsies. The experience was a great opportunity to dip my toes into what is required to reintroduce species into an area.

CONSERVATION OF THE MACAW

As humans continue to expand their influence across the globe there has been a drastic negative affect on the natural world. This has lead to what many call the sixth great extinction. While we have not found a strategy to full negate negative human induced affects on the world many strategies have been adopted to combat this loss of biodiversity. Conservation is the protection of wildlife and their ecosystems through the creation of reservations, listing species as protected, creating breeding projects, and many other avenues. During the month of July I participated in a breed and release project of Scarlet and Great Green Macaws in Costa Rica as a strategy to increase the wild population. While most of my duties included daily care of these birds, it was an opportunity to gain insight into what it takes to bring a species back from the brink of extinction. From nutrition management to human adversion training, there are many aspects in maintaining an indidivual's ability to be wild while also allowing for occasional human intervention especially in a species that is highly social and intelligent.

Board 16

ALI AMER

Research Mentor: Jacob. J. Junco – Rabin Lab
Texas Children's Cancer Center, Department of Pediatrics

Children with Down syndrome (DS) have a 20-fold increased risk of developing acute lymphoblastic leukemia (ALL) and are associated with poorer outcomes than children without DS. Furthermore, DS-ALL features a unique spectrum & frequency of mutations compared to non-DS-ALL. Our study aimed to determine the oncogenic potential of CEBPD (a genetic alteration more common in DS-ALL) overexpression and other common co-occurring mutations in DS-ALL.

INVESTIGATING THE ONCOGENIC POTENTIAL OF MUTATIONS COMMON IN DOWN SYNDROME ACUTE LYMPHOBLASTIC LEUKEMIA (DS-ALL)

Patients with Down syndrome (DS) have a 20-fold increased risk of developing acute lymphoblastic leukemia (ALL) and have a poorer prognosis than children without DS. Furthermore, DS-ALL features a different spectrum of mutations compared to non-DS ALL. Our goal was to determine if overexpression of *CEBPD*, an alteration more common in DS-ALL, demonstrates greater oncogenic effects in the DS genetic background, which would provide functional data supporting the increased frequency of this alteration that is observed in DS-ALL. To test this, we overexpressed *CEBPD* via lentiviral transduction in hematopoietic stem cells from the Dp16 mouse model of DS and wild-type (WT) non-DS control mice. Next, we compared the growth of flow cytometry-sorted transduced cells in a B-cell methylcellulose colony serial replating assay to determine the oncogenic potential of tested mutations in a DS and non-DS background. *CEBPD* induced a significant ($p<0.05$) increase in B-cell colonies in the Dp16 background compared to the WT background. This effect was observed with the initial plating, but not on subsequent replating. For all conditions tested, colony counts decreased over four serial replatings, indicating that *CEBPD* overexpression alone was not sufficient to transform the cells. We also tested the effects of other alterations observed more frequently in DS-ALL, $Kras^{G12D}$ and *Flt3*. We observed no effect of $Kras^{G12D}$ on colony growth, and effects of *Flt3* mutations are pending. These results provide functional evidence of some enhanced B cell proliferation driven by *CEBPD* in the DS genetic background, which may contribute to the increased prevalence of *CEBPD*-overexpressing alterations in DS-ALL.

Board 17

WESLEY RANCHER

Research Mentor: Victor H. Gonzalez
Department of Biology, University of Kansas

Given consideration to possible effects of climate change such as, increasingly hotter temperatures and more arid and/or humid environments we tested the effects of both of these environmental stressors on bees in Lesvos, Greece. We used desiccant, which depletes water content from the organism and made two way chambers where we could have the bees exposed to the desiccant. We determined a sublethal exposure time to the desiccant and tested mild, moderate, and high exposures then tested the bees' tolerance to heat using an Elara or what is essentially an electronic controller of the temperature. We also paired the effects of starvation with desiccation and heat tolerance. We saw a significant decrease in the temperature that bees could withstand before collapse after severe exposure to desiccation.

EFFECTS OF DESICCATION, STARVATION, AND TEMPERATURE ACCLIMATION ON BEES' HEAT TOLERANCE

Drastic changes in rainfall patterns are expected under future climate change scenarios. However, desiccation tolerance (the ability of an organism to reduce water loss) remains relatively poorly explored in most species. Desiccation tolerance appears to be critical in shaping species resilience to climate change, and insects are particularly vulnerable to desiccation considering their high surface area to volume ratio, low fat storage, and relatively high metabolic rate. In this on-going research, we investigate how exposure to desiccation stress influences bees' heat tolerance. Bees are the most important pollinators of both wild and cultivated plants, and thus, this information is highly relevant to predict potential impacts on pollination services. We also assess the influence of sociality (eusocial vs solitary), body size, and nesting type (ground vs stem) on bees' responses.

Board 18

BRIANNA DEMUTH

Research Mentor: John M. Herbert
Department of Chemistry and Biochemistry,
The Ohio State University

Human trafficking is a complicated global issue and one that is very hard to get data on. It is particularly challenging in Southeast Asia where incoming and outgoing trafficking rates are high and reporting is low. We want to know why some countries are better at addressing human trafficking than others when they do not necessarily have better human rights practices. Government corruption has a lot to do with successful human trafficking policy outcomes.

DISMANTLING HUMAN TRAFFICKING: AN UPDATED COMPARATIVE STUDY ON ANTI-TRAFFICKING POLICIES AND TRANSNATIONAL ADVOCACY IN SOUTHEAST ASIA

How much advocacy power does a country have when it comes to human trafficking? We give an in-depth analysis of human trafficking, and how current advocates can increase social demands and opportunities for transnational human rights regimes. We assess how much advocacy power states possess by first updating a famous dataset called the 3P Anti-trafficking Policy Index and then apply this to members of the Association of Southeast Asian Nations via textual analysis of the US State Department's Trafficking in Persons Reports and the UNODC's Global Report on Trafficking in Persons. This dataset focuses on the major aspects of global anti-trafficking policies: prevention, protection, and prosecution, but has not been updated publicly in seven years. The data was supplemented with a case study on Thailand. We coded using Stata for data science software, and after analysis gave suggestions on what variables advocates should focus on and the social factors that help or hinder these variables. We find that overall, since the ratification of the United Nations Protocol to Prevent, Suppress and Punish Trafficking in Persons Especially Women and Children, human trafficking data and policy implementation have increased significantly. However, improvement and high scores do not necessarily correlate to better human rights practices or better victim protection. Government corruption is a large factor in the success or failure of policy outcomes and their effectiveness to suppress and prevent trafficking.

Board 19

RACHEL LESLIE

Research Mentor: Anna Pun
Department of Mathematics, Baruch College

You can split any number into smaller numbers, such as 7 into 2+5 or 3+4. These are called partitions, and with certain equations, you can assign each partition a 1 or -1. Using a particular ordering, we're wondering if when you add these 1's and -1's together consecutively, you get zero or bigger at every step.

PARTIAL SUMS IN REVERSE LEXICOGRAPHIC ORDER

Each partition of an integer can be given a sign, 1 or -1, using the integer n, the length of the partition $l(\lambda)$, and the signum function $sgn(\sigma)= (-1)^{n-l(\sigma)}$. Euler proved that the sum of all these signs is always a nonnegative number. Our conjecture states that using reverse lexicographic ordering and working from the smallest partitions to the largest, all partial sums of signs will be nonnegative as well. Unfortunately, this conjecture is still unproven. This research will help us understand the significance of reverse lexicographic ordering of partitions and why certain things are possible in this ordering but not others

Board 20

BROOKE HALL

Research Mentor: Parvati Singh
Division of Epidemiology, The Ohio State University

Eating disorders are comprised of six distinct categories including anorexia nervosa, bulimia nervosa, and binge eating disorder all that negatively alter one's health and daily life. It is well known that eating disorder behaviors such as restriction, binging, purging, and excessive exercise can follow uncertain life events such as the onset of the COVID-19 pandemic. My narrative review analyzed previous research to evaluate how eating disorder behavior in U.S. college students was impacted by the COVID-19 pandemic.

EATING DISORDERS AMONG COLLEGE STUDENTS DURING THE COVID-19 PANDEMIC IN THE UNITED STATES: A NARRATIVE REVIEW

Eating disorders are a broad range of conditions involving negative eating behaviors such as binging and excessive exercise that alter one's health and daily life. Young adults are at heightened risk of developing eating disorders due to life changes during college years. The COVID-19 pandemic has led to job loss, financial difficulties, food insecurity, and uncertainty about the future. This narrative review investigates how the COVID-19 pandemic influenced eating disorder behavior in United States college students. Relevant articles were retrieved from PubMed, CINAHL Plus, and Web of Science in June 2022. Specific sets of search terms were used to find useful articles to review. Included studies were done during March 2020 to June 2022 and examined U.S. college students changes in eating behaviors during the COVID-19 pandemic. Seven relevant studies were included. Four were cross-sectional descriptive studies with three being longitudinal descriptive studies. Across the seven studies, there was an approximate total of 13,051 college students assessed. The studies analyzed stress, anxiety, change in food choices, and eating behaviors following the onset of the COVID-19 pandemic. Stress and anxiety were exacerbated by the COVID-19 pandemic and influenced an increase in maladaptive eating behaviors such as overeating and undereating in college students. Students who faced food insecurity or who lived independently exhibited an increase in overeating techniques, specifically binge-eating and bulimia nervosa, more so than restrictive disorders such as anorexia nervosa. The coronavirus pandemic aggravated stress, anxiety, food insecurity and independent living. Exacerbation of these factors has led to increases in poor eating behaviors such as food restriction and over-indulgence, all that can increase risk for developing eating disorders.

Board 21

NILADRI DEB

Research Mentor: Ralf Bundschuh
Department of Physics, The Ohio State University

Proteins are important for cells and they bind with Ribonucleic Acid (RNA) Molecules. We know how proteins bind with RNA but to understand how strongly they bind we use a software called RBPBind. The software was restricted to a limited number of proteins. We modified the software to accept a much broader range of proteins.

IMPROVING PREDICTION ACCURACY OF RBPBIND BY INCLUDING VARIABLE FOOTPRINT

Proteins and Ribonucleic Acids (RNA) are crucial for the everyday tasks of cells. Proteins and RNA often bind together and it is important to know how well which protein binds which RNA. We have software available to us that helps us determine the binding affinities for some proteins and a given RNA sequence. However, this software depends on the footprint size of the protein, which is the number of nucleotides that the protein molecule binds with at a time, and it is a fixed size. Thus, proteins that have a variable footprint size will not be supported by this software. Hence, we wanted to find out if adding a variable footprint size to the RBPBind software would improve its prediction accuracy. This would make the software applicable to both proteins with a fixed footprint size and proteins with variable footprint sizes, which could help us understand the biological significance of these additional proteins. The software was modified and we additionally generated the site occupancy for each nucleotide for different PUM2 footprints using the penalties in the form of change in Gibbs free energy for each nucleotide at each position published on PUM2 in "A Quantitative and Predictive Model for RNA Binding by Human Pumilio Proteins". We then tested our model by comparing the predicted change in Gibbs free energy from our model to the measured Gibbs free energy changes from the literature (Jarmoskaite et al., Mol. Cell, 966, 2019). As we incorporated additional, variable footprints, the predicted binding affinities became closer to the measured values. Thus, we conclude that adding multiple footprint sizes to RBPBind increases the prediction accuracy of the software.

Board 22

CATIE HYATT

Research Mentors: Heather Fair[1] and Ramon Carreno[2]
Pelican Harbor Seabird Station[1], Department of Biological Sciences, Ohio Wesleyan University[2]

I interned at Pelican Harbor Seabird Station for three months down in Miami, Florida. There, I was able to gain hands-on experience working at a wildlife station that functions as a clinic, a rehab, and education center.

CONSERVATION AND EDUCATION: AN INTERNSHIP WITH PELICAN HARBOR SEABIRD STATION

Wildlife conservation and education are increasingly important as our world changes around us, and humans come into contact with wildlife frequently. Unlike our domesticated furry friends, wildlife animals do not have advocates with them all the time to get them the help they need. I want to work in the wildlife sector of animal science in the future, so I packed up and went to Miami, Florida to work with seabirds and other Florida wildlife for three months. At the clinic I was taught how to identify animals, learned what medications to use and how to determine dosage, draw up and administer subcutaneous fluids, set splits, read x-rays, and other general husbandry for wildlife. I also went on education programs to help education groups of all ages about what Pelican Harbor does, why wildlife is important, and how they can help in conservation every day. Working down at Pelican Harbor gave me invaluable experience into the inner workings of a wildlife clinic, rehabilitation, and education center.

Board 23

MYLES STEED

Research Mentors: Clifton L. Ricaña, Savannah Brancato, Volker Vogt, and Robert A. Dick
Department of Molecular Biology and Genetics, Cornell University, MBG-REU program

Jaagsiekte Sheep Retrovirus (JSRV) is a virus that is known to cause lung cancer in sheep. JSRV's genetic composition is similar to other viruses such as HIV, so it was thought that the structure of JSRV would be related as well. Furthermore, a chemical made naturally in cells known as inositol hexaphosphate (IP6) has been found to be needed for forming the structure of HIV and contribute to further disease, however, little is known about IP6's effect on JSRV. To study these questions about JSRV we utilized microscopy and biochemical lab techniques in the hopes to identify viral targets for treatment.

CHARACTERIZATION OF THE EFFECTS OF IP6 ON JAAGSIEKTE SHEEP RETROVIRUS (JSRV) ASSEMBLY

Jaagsiekte Sheep Retrovirus (JSRV) is a retrovirus that causes ovine pulmonary adenocarcinoma. As for other retroviruses, the structural protein of JSRV is Gag, which is a multi-domain protein. In assembly of a virus particle, several thousand molecules of Gag come together to form the immature lattice. During the maturation process of JSRV, the viral protease cleaves the Gag on the interior side of the viral membrane releasing the CA subdomain, which is necessary for formation of an infectious virus. The lattice structures formed by Gag and by the released CA domain differ from each other, but are known for other retroviruses such as HIV-1, though less is known for JSRV. To better understand the transition between the two distinct lattices, we wish to determine the structure of the immature lattice of JSRV, which can be formed in vitro from a truncated Gag protein including CA and the adjacent NC domain. And we want to understand how cofactors like inositol hexaphosphate (IP6) affect maturation of the CA lattice. We used the following approaches to address these two unknowns. To study the JSRV CA-NC lattice assembly *in vitro*, we introduced an expression plasmid encoding CA-NC into E. coli, purify the translated immature CA-NC protein, incubate the protein under conditions where it will form immature virus-like particles, and then solve the structure of the lattice utilizing single particle cryo-electron microscopy. To study the role of IP6 on JSRV assembly, budding, and maturation *in vivo*, we transfected a plasmid expressing Gag into both wild-type and IP6-deficient mammalian cells and measured the release of virus particles from cells and the level of maturation by immunoblotting. Results from these experiments will allow us to identify key targets for antiretroviral development.

Board 24

JOSEPHINA FORNARA
LILLIAN HAMBRIC

Research Mentors: Laurel Anderson and Dustin Reichard
Department of Biological Sciences, Ohio Wesleyan University

Understanding what causes some bird's nests to successfully produce young and others to get eaten by predators is essential for directing effective conservation efforts. With this in mind, we wanted to know whether the amount of foliage concealing a nest determines the types of predators that will attack it — for example, are foxes significantly more likely than snakes to attack a well-concealed nest? To tackle this question, we spent six weeks in New Mexico using trail cameras to monitor the nests of Black-throated Sparrows, a common desert songbird. So far, our camera images have revealed that a variety of predators prey on Black-throated Sparrow nests, though we have not yet identified any relationships between nest-site vegetation and specific nest predators.

CAUGHT IN THE ACT: INVESTIGATING THE RELATIONSHIP BETWEEN SONGBIRD NEST MICROHABITATS AND PREDATION IN A DESERT ENVIRONMENT

Predation is by far the leading cause of nest failure in birds. Consequently, birds should benefit from choosing nest locations that reduce the risk of predation by limiting predators' ability to detect nests (i.e. nest concealment hypothesis). To understand how nest concealment and other nest-site vegetation characteristics affect the likelihood of predation by specific predators, we monitored the nests of free-living Black-throated Sparrows *(Amphispiza bilineata)* at the Sevilleta National Wildlife Refuge in central New Mexico. Of the twenty-four nests that we observed, seven fledged successfully (29.2%), nine were predated (37.5%), and eight were still active at the conclusion of our study (33.3%). We used camera traps to monitor the activity at each nest and to identify the predators responsible for each nest failure. After a nest became inactive (i.e. fledged or failed), we removed the camera trap and measured the height and diameter of the nest shrub, the average number of branches offering lateral concealment of the nest, and the distance to the nearest shrub/agave in each of the four cardinal directions. We also used fifty-meter transects to survey shrub/agave diversity in the vicinity of the nest shrub. Preliminary results show that a Brown-headed Cowbird, a snake, and a fox were responsible for three of the predation events, but our analysis is ongoing. Thus far, our results do not demonstrate a clear relationship between nest-site vegetation characteristics and specific nest predators.

Board 25

HANNAH COX

Research Mentor: John Krygier
Department of Environment & Sustainability, Ohio Wesleyan University

Sea turtle conservation and research is essential work being done for the overall health of the Loggerhead Sea Turtle population nesting in Kyparissia Bay, Greece. My hands-on involvement with Loggerhead Sea Turtles in Greece while interning for Global Vision International (GVI), we assisted Archelon (The Sea Turtle Protection Society of Greece) in their 30 year long conservation efforts for the vulnerable population. The population of sea turtles have been steadily increasing since the founding of Archelon in 1983.

LOGGERHEAD SEA TURTLE CONSERVATION IN GREECE

In the west coast of the Peloponnese in Greece lies Kyparissia Bay, 44 km of sandy nesting beaches for one of the largest Loggerhead Sea Turtle populations in the Mediterranean Sea. Global Vision International (GVI) has aided Archelon (the Sea Turtle Protection Society of Greece) since 2016 in their conservation efforts of the Loggerhead population. During the nesting and hatching season, GVI covers two of the eleven total beaches along Kyparissia Bay. While being there for four weeks during the beginning of the 2022 nesting season, I assisted GVI and Archelon members obtain nesting data. We went on daily morning surveys to locate and protect loggerhead nests with grids or cages from being disturbed by predators. If the nest was measured under 14 meters from the sea, it was deemed vulnerable to inundation of seawater and relocated further back from the ocean. This work has been done every year for the past 39 years. Since the founding of Archelon, there has been a gradual increase in the number of nests laid each year. Therefore, it is reasonable to assume that due to the conservation work Archelon, and now GVI, are doing in Kyparissia Bay, the Loggerhead population is not declining but steadily increasing.

Board 26

MINDI KLAUS

Research Mentor: Wendy Bollag
Department of Physiology, Augusta University

Many people around the world suffer from the skin disease psoriasis. The use of DOPG as a treatment for the illness was previously tested and showed promising results, however DOPG is a large lipid that does not permeate the skin easily. Our study examined the use of DMPG (a smaller, more permeable lipid) in treating psoriasis in both a cellular model and a mouse model. Preliminary findings suggest that DMPG is effective in treating psoriasis and has the potential to be used in a clinical setting.

DMPG AS A POSSIBLE TREATMENT FOR PSORIASIS

Psoriasis is an immune-mediated skin disease that effects a large population of people worldwide. It is characterized by abnormal differentiation and excessive proliferation of keratinocytes, as well as an overactive immune response that causes inflammation. Previously, it was shown that Dioleoylphosphatidylglycerol (DOPG) inhibits toll-like receptors and can reduce inflammation in psoriasis in both an in vitro and an in vivo model. However, DOPG is quite large and does not permeate the skin very easily. This led to the possibility of using an alternative phosphatidylglycerol: Dimyristoyl phospatidylglycerol (DMPG), which is somewhat smaller and more permeable than DOPG. To test this, cells were treated in vitro with a damage-associated molecular pattern (DAMP) called PAM and then DMPG. RNA was isolated, cDNA made, and qPCR ran with inflammatory markers, showing that DMPG similarly inhibits toll-like receptors and decreases psoriasis-like inflammation. The Imiquimod mouse model was also executed, in which 20 male mice were shaved on their backs and placed into one of four groups: control, DMPG, Imiquimod (IMQ), and IMQ+DMPG. In the morning, each mouse was treated topically with either Vaseline or IMQ, and then in the afternoon, treatment with PBS or DMPG was administered topically. On the seventh day, the animals were sacrificed and the back skin, the right ear, and spleen were harvested. Preliminary results indicate that DMPG was effective in decreasing inflammation and skin thickness in the IMQ model, although some trends did not reach significance, suggesting too low of a DMPG dose was used. The phenotype of the mice improved with DMPG as well. Western blot analysis still needs to be completed, and the images of the backs of the mice will be sent to a third party, unbiased dermatologist who will give them Psoriasis Area Severity Index (PASI) scores. Data collected so far suggests that DMPG may have the potential to be used in treating psoriasis in a clinical setting.

Board 27

MAYA MOORE

Research Mentor: Sarah Woodley
Department of Biological Sciences, Bayer School of Natural and Environmental Sciences, Duquesne University

Sperm competition is a reproductive phenomenon common in species where females mate with multiple males during a breeding season. This study used vertebrate models, Allegheny Mountain Dusky salamanders, to study what factors may cause a male to alter his sperm. In one experiment, we exposed males to chemical cues from rival males, and in a second experiment, we exposed males to higher levels of testosterone. By examining sperm, we can better understand fertility for conservation efforts and for humans as well.

SPERM COMPETITION IN DUSKY SALAMANDERS

Sperm competition, a form of sexual selection, occurs when males compete for fertilizations after copulation. Sperm competition is common in species where females mate multiple times, and males may invest differently in sperm number and seminal factors. I studied sperm competition in salamanders *(Desmognathus ochrophaeus)*, where females mate with multiple males and store sperm internally until fertilization, which may occur months later. Males transfer sperm to females using a spermatophore. We hypothesized that males make larger spermatophores in the presence of rival male pheromones. Each male mated with the same female twice: once with a substrate saturated with rival male pheromones and once with a control substrate. There was no effect of rival male cues on spermatophore size. The time since last mating had a greater effect on spermatophore size, perhaps because spermatophores are energetically costly to produce. We also tested whether testosterone affects spermatophore size. We applied transdermal testosterone and an oil control to males and found that they produce larger spermatophores when exposed to higher levels of testosterone. We are extracting DNA from the spermatophore to estimate sperm number as well as protein content. Because salamanders are vertebrates, these data may be used to further understand fertility issues in humans as well as for species conservation efforts. Funded by NSF-REU Site Award 1757555.

Board 28

HANNAH GREEN

Research Mentors: Abigail Crites
Astrophysics Department, Cornell University

CMB-S4 is a network of telescopes that will be begin taking data in 2029. It hopes to confirm or deny current theories about the state of the very early universe, as well as map dark matter in our universe. My research involved making the software that interacts with these telescopes easier to install and write through thorough documentation, as well coding simulations of hardware that can be used to help others make their own software.

DOCUMENTATION OF SOCS AND HARDWARE SIMULATION FOR CMB-S4

Simons Observatory's Observatory Control System (SOCS) is being used as the framework for CMB-S4's overall data acquisition system (DAQ). In this project, we focused mainly on documenting and researching OCS, as prior to this point, it was used as a part of a small-scale DAQ. CMB-S4 is a seven-year survey aimed at answering questions on the earliest stages of the universe through the study of gravitational waves. It consists of 18 small aperture telescopes and 6 large aperture telescopes spread throughout two sites located in Chile and the south pole, compared to Simons' total of four telescopes. Due to the difference of these project's scale, SOCS has documentation currently directed solely at the researchers who work at Simons'. In CMB-S4, researchers must be able to install and run SOCS on the fly, and this will require much more thorough documentation than what's currently available. This summer, we documented the installation of SOCS on a clean computer running windows, and began the documentation of what building a software agent to interact with telescope hardware would entail. Future plans involve continuing this process, as well as beginning to simulate certain hardware in order to aid the creation of other necessary agents down the line.

Board 29

MALCOLM HENDERSON

Research Mentor: John Blondin
Department of Physics, North Carolina State University

When a neutron star orbits a massive supergiant companion, it gravitationally captures material that is expelled from the supergiant. As the material falls onto the neutron star, it heats up and emits X-rays. The X-rays affect the material coming off the supergiant by slowing and heating it, which in turn influences how that material is captured by the neutron star. I am studying how this interaction affects the system over a long period of time.

VARIATIONS IN MASS ACCRETION RATE IN A HIGH-MASS X-RAY BINARY SYSTEM

Binary systems consisting of an OB supergiant star and a compact companion can produce X-ray emissions when mass from the stellar wind of the supergiant is accreted onto the compact companion. These systems are called high mass X-ray binaries (HMXBs). In these systems, the X-ray emissions from the compact object can heat ionize the stellar wind from the OB supergiant, stopping it from being accelerated. This creates a slower wind that produces a higher mass accretion rate and therefore higher X-ray luminosity. This continues until the X-ray luminosity is high enough to cut off the solar wind, causing the mass accretion and X-ray luminosity to drop. This cycle creates a variable mass accretion rate. I will be using hydrodynamic simulations to model the HMXB system Vela X-1 in 2 and 3 dimensions to observe the rate at which mass is accreted onto the neutron star in the system over a period of time. I will be using the hydrodynamic models to find if there are any stable states in the mass accretion rate and under what conditions those stable states might occur.

Board 30

IVAN VORE

Research Mentors: Kou-San Ju and Jerry Cui
Department of Microbiology, The Ohio State University

The rise of drug-resistant pathogens presents an urgent need for new developments in antibiotic research. The Ju Research Group specializes in the study of organically-produced compounds capable of mimicking essential nutrients used in basic metabolism. The goal of our research is to uncover new compounds produced in microorganisms for use in medicine and industry. My work in the lab is focused on the structure and function of a fundamental protein used in the creation of these antibiotic compounds we study.

ATYPICAL KEY ENZYMES IN PHOSPHONATE NATURAL PRODUCT BIOSYNTHESIS

Phosphonate natural products are antimetabolites defined by their carbon-phosphorus bond. This class of compounds exhibits cytotoxic properties by mimicking common molecules in essential metabolism, making them potent antibiotic, herbicidal, antifungal, and anticancer compounds. The mining of genomic data for phosphonate natural products in microorganisms has provided us with a rich source of newly available compounds in medicine and industry. Genome mining for phosphonate natural product biosynthetic gene clusters (BGCs) is conducted by locating the protein-coding gene *pepM*. The product of this gene, phosphoenolpyruvate mutase (PepM) is responsible for the first step of all known phosphonate biosynthesis: creating the carbon-phosphorus bond that defines all phosphonates. Our analyses of microbial genomes have revealed potential homologs of PepM that lack a defining motif, which has been utilized to distinguish the phosphonate-forming PepM enzyme from ancestral relatives. Yet, their encoding biosynthetic gene clusters contain other known genes for phosphonate biosynthesis within their neighborhoods, suggesting they may indeed catalyze the formation of the carbon-phosphorus bond. Here, we test this hypothesis by examining the biochemical function of two atypical PepM homologs from *Mesorhizobium sanjuanii* and *Streptacidiphilus rugosus*. Understanding the function of these two enzymes will lead to a greater definition of phosphonate biosynthesis and potentially expand the number of pathways for this family of natural products.

Board 31

MADELINE RUSSELL

Research Mentor: Timothy Mahnke
Hikma Pharmaceuticals

Microbes exist in all environments that we work in and must be monitored for consumer safety. The microbiome of the Hikma Pharmaceutical facilities was analyzed by gathering samples with either surface contact agar plates or with air samples. The growth was transferred to test cards and allowed to grow for 24-48 hours. Growth was identified using a computer identification program and results were noted in a report.

CATALOGING OF ENVIRONMENTAL ISOLATES AT HIKMA PHARMACEUTICALS

The manufacturing and packaging environment in which various pharmaceutical products are produced is strictly controlled since it could have a direct impact on the final product and subsequently, for the consumer. Environmental monitoring of the manufacturing and packaging areas allows for a check that ensures that the areas are in a state of control and ultimately, the safety of the consumer using the product. Having a catalog of microorganisms will assist in determining normal microbiological flora in these areas. This will ultimately aid in a better control strategy for these environments. Through the course of the research, multiple samples were collected from several different areas across Hikma's facilities. Samples were grown on either Dey-Engley neutralizing agar from a solid surface or grown on a Tryptic Soy agar plate using an air sampler. Once the isolates had grown, the microorganisms were subcultured using a sterile loop and streaked for isolation onto Tryptic Soy agar plates. These plates were incubated at 30-35ºC for 24-48 hours. After this, the isolates were transferred to test cards containing a variety of nutrients, antibiotics, and other compounds. These test cards were incubated at 30-35ºC for 24 hours. After incubation, the test cards were loaded into a computerized identification system, their data was input into the software, and an identification was generated. If no identification was generated, the plates were either allowed to incubate an additional 24 hours or tested again utilizing a different inoculating fluid medium. All identifications were recorded by area and a final report summarizing the findings of the facility microbiome was produced.

Board 32

KAYLA RUSH

Supervisor: Brian Fagan, Supervisory Special Agent
Department of Justice, FBI, Quantico, VA

FBI HONORS INTERNSHIP

I took part in a ten week internship with the laboratory division of the Federal Bureau of Investigation. I worked with the Evidence Response Team Unit. They work to train teams in all the FBI's field offices to ensure evidence is collected and processed in a way that is consistent and able to be analyzed successfully by the laboratory. I was able to observe classes in a variety of forensic disciplines like fingerprinting, hazmat chemistry, crime scene photography and biological threat detection. I was able to observe all of the forensic analyses that the lab is capable of performing like DNA, finger and latent prints, trace evidence like hairs and fibers and toxicology. I saw and learned something new everyday and got both a laboratory and agent/field perspective of the work of the FBI. Some projects I completed were assisting with the production and translation of materials for an international training program, analyzing and inputting data to ensure all hazmat certified staff are eligible to go downrange and designing an informational display board to highlight everything that the unit does. In order to obtain this internship, after the application and interview process I had to undergo a polygraph examination, security interview, and a thorough background check which spanned 6 months to receive a top secret security clearance. I will continue my service into the school year working part time at the local Columbus office.

Board 33

LISA LEONARD

Research Mentor: Moriah Young
W.K. Kellogg Biological Station LTER

Drought is a very common environmental stressor, with a significant increase in severity and frequency of drought events, it is important to understand how this may affect plants but also soil microbes. In this study, we wanted to understand whether or not a past years drought would affect this years plant growth with *Triticum aestivum*, common wheat.

DOES A DROUGHT LEGACY EFFECT *TRITICUM AESTIVUM* GROWTH?

Drought is a major abiotic stressor to not only plants, but soil microbes. Plants and soil are inherently interconnected and the relationship between them can determine the health of both the plant as well as the soil. In this study, we looked at the effects of a previous years' drought on the growth of *Triticum aestivum*, common wheat. Using the Rainfall Exclusion eXperiment (REX) in the LTER at W.K. Kellogg Biological Station, we measured height, greenness, and biomass on wheat. These measurements were conducted in the no till treatments (T2s) and in the drought legacy, irrigated control, and drought footprints with the fungicide and control subplots. A SPAD was used to measure greenness, a proxy for chlorophyll content in leaves. Wheat was harvested in the treatment area, dried, and then weighed for biomass. We expected that drought legacy plots and fungicide subplots would have shorter heights, lower greenness, and less biomass. We found no significant differences between greenness and biomass between each treatment. However, there was a difference in height between the irrigated control and drought legacy fungicide suplots, with the irrigated control plots having lower average heights. This is the opposite of what we expected from our hypothesis. Because the 6-week drought had not started yet, we would not expect an effect from the drought in those footprints. Further, soil microbes could potentially be resilient, resistant, or functionally redundant in their response to the previous years' drought which could be why we did not see any drought legacy effects on wheat greenness or biomass. Soil samples are being collected to compare the fungal and bacterial communities within these same plots in order to explain their responses to the treatments. It is crucial to understand these plant-soil feedbacks as climate change increases and how plants and soil microbes adapt to the changes within the environment.

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TREY THEOBALD

Research Mentors: Ethan Lippmann[1,2], Andrew Kjar[1]
[1]Department of Biomedical Engineering, Vanderbilt University
[2] Department of Chemical and Biomolecular Engineering, Vanderbilt University

In drug development, human clinical trials are used to screen for toxicity and side effects in patient populations. Due to the uncertainty of these side effects as well as their severity, pregnant individuals are generally excluded from such trials to prevent injury to the developing fetus. In this project, human brain cells are grown in a pattern that mimics the development of the fetus thereby providing a way to test medication safety without endangering an infant's life.

IDENTIFYING EARLY DEVELOPMENTAL NEUROTOXICITY MODELED IN A CEREBRAL ORGANOID SYSTEM

Pregnant individuals are typically excluded from traditional clinical trials due to ethical and safety concerns for the fetus. This lack of data leads to challenges in managing the health concerns of the expectant patient while also protecting the developing fetus from neurologically damaging medications. To be able to effectively understand how certain medications impact fetal neurodevelopment, alternative screening methods for neurotoxicity are essential. Here, we provide a scalable, human specific model for neurological drug toxicity screening using human induced pluripotent stem cell derived cerebral organoids that model the growth and layering of the developing fetal brain. In control organoids, neural progenitors ($SOX2^+/PAX6^+$) comprised the center of the tissue while mature neurons ($ßIII T^+/TBR1^+$) formed the outer surface. We tested gabapentin for neurotoxicity using folic acid and valproic acid as controls to verify the sensitivity of our system. Size and shape characterization over 30 days revealed that folic acid and gabapentin drug concentration did not affect the growth kinetics of organoids while organoids dosed with valproic acid exhibited a decreased growth rate at a concentration of 10 mM. Secondary cell titer assays revealed decreased viability in organoids with high concentrations of valproic acid, confirming the size characterization. Preliminary spinning disc confocal imaging indicated that organoids dosed with 10mM valproic acid exhibited few $ßIII T^+$ cells. Future development of our high throughput screening organoid model will provide an ethical and efficient method of evaluating neurotoxicity for early developmental and fetal populations.

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MAIZY PRATT

Research Mentor: André O. Hudson
Department of Life Sciences, Rochester Institute of Technology

Aquatic plastic pollution is a well-known problem with many familiar consequences, but with the COVID-19 pandemic, a whole new genre of plastic pollution has been introduced to the environment — disposable masks. Studies have shown that bacteria colonize plastics, but not many have examined disposable masks specifically. The purpose of this study is to identify antibiotic resistant and potentially pathogenic bacteria that colonize disposable masks, in order to close gaps in knowledge concerning public health risks associated with modern plastic pollution.

DISPOSABLE MASKS AS A SOURCE OF ANTIBIOTIC RESISTANCE IN STORMWATER PONDS

The COVID-19 Pandemic has permanently changed how human beings live and interact with one another in addition to the environment, and one of the most iconic markers of that shift is masks. There is limited research on disposable masks as plastic pollution, especially concerning the potential health risks as a result of harboring and vectoring pathogenic bacteria. Thus, this study identifies pathogenic and antibiotic-resistant bacteria colonizing masks in stormwater ponds. Masks were collected from multiple ponds in the greater Rochester area. Bacterial cultures were grown and isolated from media, identified via PCR amplification and sequencing of the variable 3 and 4 regions of the 16S rDNA. Assays exposing a subset of these isolated bacteria to antibiotics show the presence of antibiotic-resistant bacteria on disposable masks, and suggest potential for downstream human and environmental health risks.

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

SSRP 2021

Cece Colwell '22 – Genetic Counselor Assistant at Nationwide Children's Hospital

Ciara Pettit '23 – Summer animal care at OWU, job at vet clinic or Columbus Zoo and Aquarium, fall study abroad experience in Mexico

Myles Steed '23 – REU at Cornell University in Molecular Biology and Genetics with Dr. Volker Vogt, focusing on the structure and assembly of HIV

Josie Fornara '23 – Research at the University of New Mexico Sevilleta Field Station on the relationship between nest-site vegetation and predation. This is a Connection Grant-funded senior project for graduation with honors.

Navami Shenoy '23 – Summer research internship

Brianna DeMuth '23 – BTAA Summer Research Opportunities Program at the University of Iowa Graduate College researching the political economics and cost-benefit analysis surrounding human rights and authoritarianism.

Tiyinoluwa Olushola-Alao '23 – Summer Campus Lead for OWU Summer Camp and Conferences

Eva Mulloy '22 – Physics and Astronomy graduate program at Bowling Green State University

Cassie Farber '22 – Patient Care Technician at Fresenius Medical Care, responsible for running dialysis; currently applying to medical school

Emma Zajac '23 – Study abroad in Dakar, Senegal; medical internship; shadowing a neurologist this fall

SSRP 2020

Princeton Vaughn '22 – Ecology and Evolutionary Biology Ph.D. program at Princeton University

Emma Blackburn '22 – Integrated Life Sciences graduate Program at the University of Georgia

Hanna Cao '22 – Gap year traveling in China; pursuing a Ph.D. in Economics

Kaito Iwasaki '23 – Math REU program at Cornell University

Sakshi Gupta '22 – Physics graduate program at Bowling Green State University

Chase Patton '22 – Summer job at the Columbus Zoo and Aquarium; pursuing a master's degree in Biology at Miami University in fall 2022

Sierra Spears '22 – Field technician in Puerto Rico with a research team from Yale University studying lizards

SSRP 2019

Hien Mai '22 – Neuroscience graduate program at The Ohio State University

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