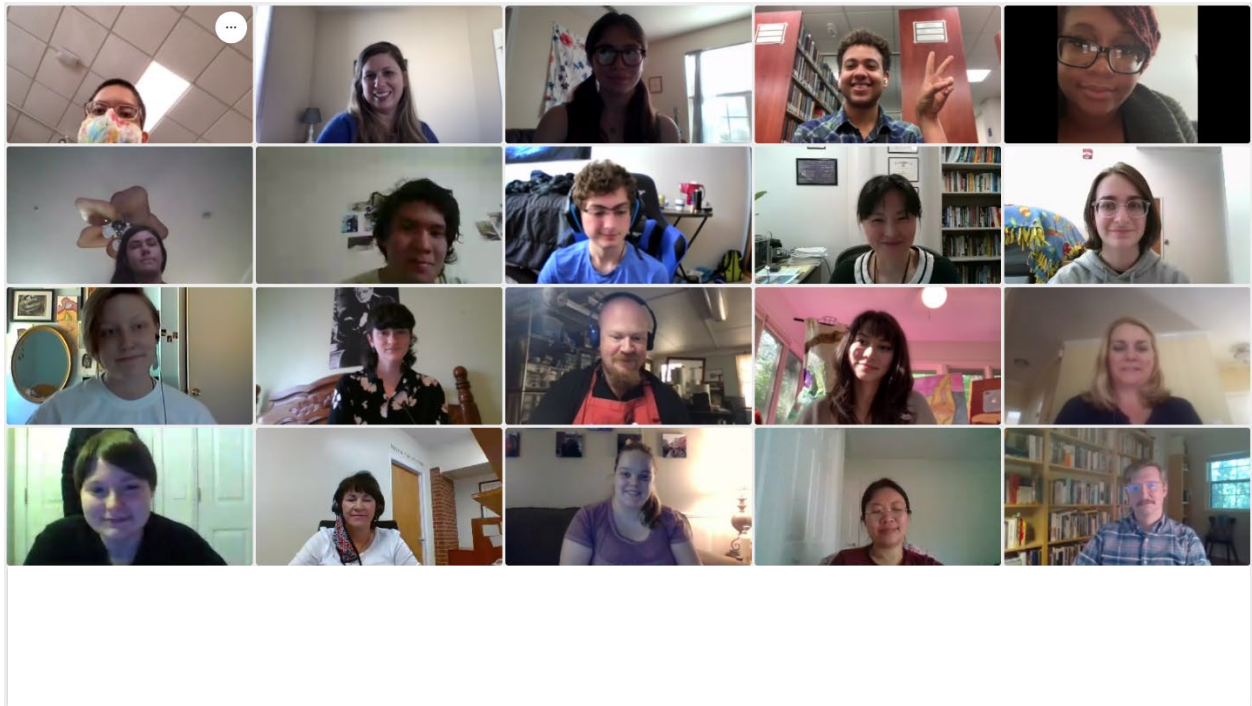


Fifteenth Annual  
UNC Pembroke  
Undergraduate Research and Creativity Symposium



Program with Abstracts



Pembroke Undergraduate Research and  
Creativity (PURC) Center



One University Dr.  
P. O. Box 1510  
Pembroke, NC 28372-1510

June 20<sup>th</sup>, 2021

Dear Students and Colleagues:

As was the case with the March 2020 Symposium, the UNC Pembroke Undergraduate Research and Creativity Center (PURC) staff and our PURC Advisory Council members were again forced to cancel an in-person event for the 15<sup>th</sup> Annual PURC Symposium due to the ongoing Covid-19 pandemic. Therefore, the 15<sup>th</sup> annual symposium was held virtually but in a real-time WebEx format for presenters and attendees.

Presentations during this abbreviated virtual platform were limited to the Keynote Speaker, the PURC funded students, awarding of the Outstanding Undergraduate Research Mentor award, and the announcement of the newly established Dr. Timothy Ritter and Marie A. Amero Endowed Research Scholarship. Other UNCP undergraduate students who were not supported by PURC funding were invited have abstracts, posters, videos, and/or three-minute lightning talks (3MTs) included in the web published 15<sup>th</sup> Annual Symposium Program booklet.

Again, to allow students and their faculty mentors the time, freedom, and support that would allow as many students as possible to share their important research and creativity projects with the public, the deadlines were extended.

We have gathered all submitted materials and present it for your enjoyment and edification here in this online program. In addition, a video of the real-time Symposium will be included on the PURC website to accompany the program

I would like to thank the dedicated members of our UNCP PURC Advisory Council, the support of the Office of Academic Affairs, the Provost, and the Chancellor; we look forward to next year and a renewal of our more standard symposium event.

**CONGRATULATIONS TO ALL OF OUR STUDENT SCHOLARS AND THEIR FACULTY MENTORS** on their successes and their determination.

A handwritten signature in cursive script, appearing to read "Rebecca Bullard-Dillard".

Rebecca Bullard-Dillard, Ph.D.  
PURC Director  
Professor of Chemistry

## PURC Student Funding Opportunities

PURC provides five types of opportunities for undergraduates interested in pursuing mentored research.

- Student Travel Funds (STF) assist with travel for research, presentation of extracurricular projects or exhibits, meetings, and performances.
- Student Scholarship Support (S3) funds short-term extracurricular research, creative projects, entrepreneurial, and scholarly endeavors.
- Semester Undergraduate Research Fellowships (SURF) fund extracurricular research, creative, entrepreneurial, and scholarly endeavors during the academic year.
- Undergraduate Research Fellowships – Summer (URFS) fund extracurricular research, creative, entrepreneurial, and scholarly endeavors during summer sessions.
- For students, especially those developing in the early portion of their career here at UNCP, the Dr. Charles Humphrey Undergraduate Conference Travel Award exists to fund travel to regional conferences.



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**NOTE: Abstracts titles in [Blue](#) font are hotlinks to poster or other media file URLs.**

## 2021 PURC Symposium Live On-Line Program Agenda

Monday, April 26, 2021

Online via WebEx

Opening Greeting	Dr. Rebecca Bullard-Dillard	3:00 – 3:10 pm
Introduction of Key Note Speaker	Dr. XinYan Shi	3:10 -- 3:15pm
Key Note Address	Dr. Ishuan Li	3:15 – 3:45 pm
<b>BREAK</b>		3:45 – 4:00pm
<b>PURC Student Presentations</b>	<ul style="list-style-type: none"> <li>• Student Presenter: Macaela Locklear</li> <li>• Faculty Mentor Dr. Kaitlin Campbell</li> <li>• Presentation Title: Bee and wasp use of native bee houses at the UNCP Campus Garden and Apiary</li> </ul>	4:00 – 4:45 pm
	<ul style="list-style-type: none"> <li>• Student Presenter: Abigail Canela</li> <li>• Faculty Mentor: Dr. Kaitlin Campbell</li> <li>• Presentation Title: Flower Visitations and Preferences Among Insect Pollinators in Southeastern NC</li> </ul>	
	<ul style="list-style-type: none"> <li>• Student Presenter: Kelsey Pearce</li> <li>• Faculty Mentor: Dr. Brandon Sanderson</li> <li>• Presentation Title: Art Therapy for the Covid Weary</li> </ul>	
	<ul style="list-style-type: none"> <li>• Student Presenter: Neena (Jade) Baker</li> <li>• Faculty Mentor: Dr. Brandon Sanderson</li> <li>• Presentation Title: Relationships in the Pandemic</li> </ul>	
Introduction of Mentor Award	Maria Santisteban	4:45 – 4:50 pm
Address by Mentor of the Year	Dr. Brandon Sanderson	4:50 – 5: 10 pm
Announcement of Dr. Timothy Ritter & Marie A Amero Endowed Research Scholarship	Rebecca Bullard-Dillard -- Introduction	5:10 – 5:15pm
	Dr. Timothy Ritter or Designee – Address	5:15 – 5:25 pm
Recognition of Charles Humphries Award	Rebecca Bullard-Dillard	5:25 – 5:30pm
Closing Remarks	Renee Lamphere	5:30 – 5:35 pm

## Keynote Speaker



### **Dr. Ishuan Li**

Dr. Li is an Associate Professor of Finance at Minnesota State University Mankato. Dr. Li has a PhD in Applied Economics from Clemson University, and Masters in Economics and Political Economy from Clemson University and Fordham University. She is the President-Elect of Omicron Delta Epsilon, the International Honor Society for Economics. Dr. Li also serves as an Associate Editor for the *American Economist*, an economics journal published by Sage

Publishing. For several years, she served as a Councilor in the Division of Social Sciences at the Council of Undergraduate Research, and the Division Editor for the *Scholarship and Practice in Undergraduate Research (SPUR)*, a journal published by the Council of Undergraduate Research. Dr. Li has mentored and supervised dozens of undergraduate and graduate student research papers over the years. Her students have presented their work at various competitions, including the Minnesota Economic Association, Omicron Delta Epsilon, Poster on the Hill, NCUR, International Atlantic Economic Society, Regional Federal Reserve Banks, ICPSR, Midwest Undergraduate Data Analytics Competition, and among others.



## Undergraduate Research Mentor Award



**Dr. Brandon Sanderson**  
*2021 Award Winner*

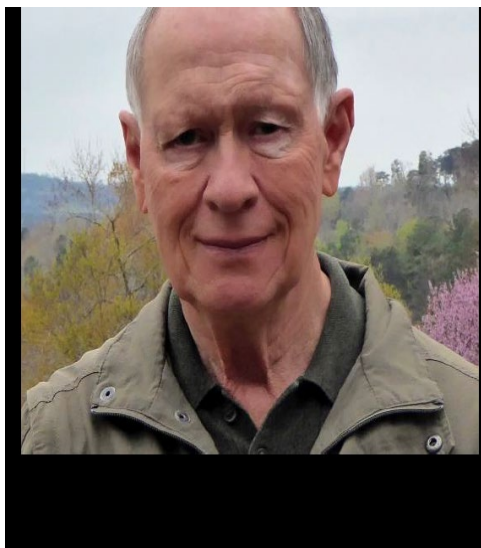
The Pembroke Undergraduate Research and Creativity Center Council is pleased to announce that Dr. Brandon Sanderson, Professor of Art, has been named the winner of this year's Undergraduate Research Mentor Award. This recognition rewards individuals who make significant contributions to forwarding undergraduate research, creative scholarship, and entrepreneurial scholarship. It highlights demonstrated excellence in supporting undergraduate researchers, encouraging mentoring relationships with undergraduate students, and conveying the campus' high regard for contributions made by the academic and research community at UNC Pembroke, particularly if a mentor supports and influences students' educational and career paths. Exemplary mentors can demonstrate continued success in helping students produce tangible results that may include peer-reviewed publications, student presentations, awards, or scholarships. Excellent undergraduate mentors support students through their availability, attentiveness, encouragement, and understanding. In many disciplines, this mentoring is done by faculty, staff, postdoctoral researchers, and graduate students.

Entering his 19th year as a professor and 25th as an artist, Brandon Sanderson is a Professor of Art teaching Printmaking and Foundations at the University of North Carolina-Pembroke. He also serves as Workshop Coordinator for Frogman's Print Workshops in Omaha, Nebraska, one of the largest printmaking workshops in the United States. Sanderson has exhibited in over 500 venues in 60 countries. Since 2018, he has shown in Poland, Wales, China, Chile, Bosnia, Uganda, Cambodia, and Colombia. He has also held 40 university lectures in 25 states and participated in 75 collaborative academic projects. He also is a long-time member of the Artnauts international art group. In his time at UNCP, he has organized dozens of exhibitions and brought in 50 visiting artists to work with faculty, students and the community.

Please join us in congratulating Dr. Sanderson as we recognize his commitment to engaging and motivating his students.

## Travel Award Benefactor:

### Dr. Charles Humphrey



Charles Humphrey graduated from Pembroke State College in 1965 with a BS in Chemistry (Cum laude) followed by 2 years as a technician at Bowman Gray Medical School. While there, he completed coursework at Bowman Gray and Wake Forest University in anticipation of entering graduate school if financial aid became available. A Fellowship was offered by Clemson University in 1967. Charles obtained a PhD in Nutrition/Biochemistry from Clemson in 1972. Charles' research interests at Clemson involved animal nutrition, infectious diseases, and use of microscopy/electron microscopy. These interests and skill-sets have kept him "hooked" his entire career.

In 2016, Dr. Humphrey generously created the "**Dr. Charles Humphrey Undergraduate Conference Travel Award**" to encourage both undergraduate research and faculty mentorship. With this award, PURC has awarded a discrete number of conference travel awards to undergraduates to attend regional, professional conferences with a faculty mentor. This award opens the door for students who have never conducted research to experience an academic conference. This year the Dr. Charles Humphrey Undergraduate Conference Travel Award has helped over three dozen students attend conferences with a faculty mentor.

It was quite unfortunate that the Covid-19 travel restrictions for the UNCP campus did not allow for support of student travel. We were unable to award the Dr. Charles Humphrey Undergraduate Conference Travel Award funds. We look forward to next year and the renewal of our efforts to allow students these critical career preparation experiences.

## Announcing the Dr. Timothy Ritter and Marie A. Amero Endowed Research Scholarship



UNCP PURC Center is happy to announce the Dr. Timothy Ritter and Marie A. Amero Endowed Research Scholarship.

This generous gift will support an undergraduate research scholar each academic year. UNCP is grateful for this support to undergraduate research endeavor.

Dr. Ritter began his career at UNC Pembroke in 1996 after graduating from the State University of New York at Buffalo (SUNY Buffalo) with a Ph.D. in condensed matter physics. From 2002 – 2014 he led a multidisciplinary, multi-University microgravity research team known as the “Weightless Lumbees”. This undergraduate research group had eight teams of students fly themselves and their experiments on NASA’s microgravity research aircraft. Dr. Ritter was also the director of the Region 4 North Carolina Science and Engineering Fair for over 15 years. Dr. Ritter’s dedication to undergraduate research led to him being selected as the second director of the Pembroke Undergraduate Research and Creativity Center (PURC). His tenure as the PURC director was interrupted when he was recalled to active duty with the United States Navy in order to serve as an assistant professor at the United States Naval Academy. Professor Ritter’s academic and military careers were cut short in 2015 when he was diagnosed with amyotrophic lateral sclerosis (ALS). Dr. Ritter and his wife Marie currently live in North Myrtle Beach South Carolina.

Each year, an award will be provided to one undergraduate student performing research in Chemistry, Physics, or Science Education Grades 9-12 (Biology, Chemistry, Earth Science, and Physics) through the Pembroke Undergraduate Research and Creativity (PURC) Center. The student shall be selected by the PURC Council. The research projects will be conducted under the guidance of a faculty mentor.

# ABSTRACTS and POSTERS

## 1 - Relationships in the pandemic

**\*\*Neena (Jade) Baker, Art**

Mentor: **Brandon Sanderson**

With the recent events of COVID-19, something that has spiked my interest is relationships during the pandemic. This unique situation has taken a toll on all aspects of life, including romantic relationships. This is something that I personally have experienced and witnessed those around me as well. Today I am showcasing this through three pieces, 2 paintings and one costume piece, demonstrating different aspects of relationships during the pandemic.

\*\*PURC Supported Scholar. [Presentation can be viewed in the April 26, 2021 live Symposium Recording](#)

## \*\*2 - Art Therapy for the Covid Weary

**Kelsey Pearce, Art**

Mentor: **Brandon Sanderson**

Art Therapy is an effective modality used to reach clients through the use of visual arts. Using Art Therapy in a group format can provide clients with a sense of community, much like the communities formed through working together in the Studio Arts program. Throughout this research, I have gathered materials and inspiration to create an interactive art therapy workshop. This workshop has been created with the cooperation and partnership of a local counseling service Plenty & Grace, whose services include equine and talk therapy. This cooperative effort works directly with practicing therapists and interns to not only diversify their modalities with clients, but also provide a much-needed repose in Covid-19 fatigue. Isolation and grief have been the theme of the last year and Covid-19 has taken a widespread toll on mental health. Creativity with community can allow a space for that shared grief while also inspiring healing by enabling the client to work internally through unprocessed emotions. Displayed are images I plan to develop into a mindfulness coloring book created specifically for Plenty & Grace. Along with this reflective coloring exercise, participants will work together to create fast paced, expressive collaborative art pieces. This workshop will follow NC Covid-19 guidelines and will take place in an outdoor setting.

\*\*PURC Supported Scholar. [Presentation can be viewed in the April 26, 2021 live Symposium Recording](#)

### 3 - Annotating *Drosophila ananassae* through the Genomic Education Partnership

**Erica Baynard**, *Biology*

Mentor: **Maria Santisteban**

Genomic Education Partnership's (GEP) main goal is to provide opportunities for undergraduate students to be involved in authentic research and makes use of the publicly available sequence assemblies that need to be annotated. Annotation entails finding where the genes are on the sequenced genome and describing their structure. Students use tools of bioinformatics such as BLAST, navigate Genome browsers, access databases like Flybase, and utilize GEP custom designed apps (Gene Record Finder, Gene Model Checker). The annotation protocol uses a comparative genomics approach, and the genomes of several *Drosophila* species are annotated using *D. melanogaster* as the genome reference.

Students contribute to a larger collaborative effort that aims to explore the special characteristics of the F Muller element, which is the fourth or dot chromosome in *D. melanogaster*. This chromosome is special in that it exhibits characteristics that are associated with highly condensed chromatin and would be expected to have silenced genes, but this is not the case. One hypothesis is that the genes in the F element have adopted features that allow them to thrive in a heterochromatic environment. Additionally, the F element is greatly expanded in a four *Drosophila* species, including the present project's *D. ananassae*. The results from students' annotations are expected to further our understanding as to how evolution impacted the change in their chromosome.

### 4 - Monitoring Changes in Bee Community Traits Across Differing Habitats

**Aaron Bowen**, *Biology*

Mentor: **Kaitlin Campbell**

Animal pollinators perform a large percentage of the total pollination across the globe annually; a vast majority of these pollinators being bees. The majority of crops cultivated for human consumption benefit, or rely on, pollination. Pollinators have shown significant decreases in abundance globally, due to destruction of habitats and use of pesticides. Understanding the nesting needs and community characteristics of bees in different habitats can help conservation. To observe the nesting habits, sociality, abundance, and diversity of bees the research team trapped and netted bees in the lawn and pollinator gardens at the UNCP Campus Garden and Robeson Community College (RCC). A total of 1150 total bees, of 51 species, was collected in 2018 and 2019. Results showed that a significantly greater number of underground-nesting bees were collected in 2018 than in 2019. Large shifts in underground-nesting bees to cavity and ground-nesting bees in 2019 were found to be driven by *Bombus* (bumblebee) species. Shifts in sociality were not clear between years, but there were more social bees in the garden than the lawn. Many of the bee species that were collected across both years were of unknown sociality due to the large numbers of highly diverse *Lasioglossum* species that lack existing ecological data. These data have great significance in understanding differences in bee

communities and their diversity. Knowing these differences can not only assist in the conservation of these important pollinators and their habitats but may also promote increased production of more diverse crops and plant life.

### **\*\*5 - Flower Visitations and Preferences Among Insect Pollinators in Southeastern NC**

**Abigail Canela**, *Biology*  
Mentors: **Kaitlin Campbell**

Pollinators are vital contributors to natural ecosystem functions but are increasingly facing challenges, including habitat loss and resource depletion. One way to support pollinator populations is by establishing a pollinator garden that offers a wide variety of flower species conducive to varying pollinator groups. However, the effects of floral abundance and richness in a garden are not well documented. Additionally, environmental variables such as temperature and light have some degree of predictive power in explaining pollinator visitation rates. We hypothesized that increased floral species richness and abundance support increases in pollinator visitations by providing different flower shapes and colors favorable to each pollinator group, and increased temperature support higher visitation rates since most pollinators are ectotherms. To assess the effects of flower abundance and richness and temperature on visitation rates, direct observations were conducted in the UNCP Campus Garden and the adjacent lawn area. 71 observation plots were established, and floral richness and abundance were recorded in each. Temperature and cloud cover were recorded at observation times. A total of 9,667 visitors were observed on 70 flower varieties during 70.25 hours of observation. Flower abundance and temperature positively affected overall visitation rates. Increased temperature positively affected native bee visitation rates and increased floral abundance positively affected butterfly visitation rates. Observations suggest evidence of specialization among visitor groups.

\*\*PURC Supported Scholar. [Presentation can be viewed in the April 26, 2021 live Symposium Recording](#)

### **6 - Modeling the Neuromuscular Junction: Bioelectrical signals that control movement, memory & thought**

**Hunter Cole and Na'Tazia Hampton**, *Biology*  
Mentors: **Robert Poage**

The neuromuscular junction (NMJ) has been historically significant in understanding synaptic transmission. The extremely rapid and spatially restricted signaling across our synapses is ultimately the driving force for higher actions such as movement, thought, and memory. Although there exist many experimental limitations on procedures that can be applied to a living NMJ. To solve this problem, MCell was designed: It is a computational Monte Carlo analysis of the NMJ using 3-D rendering of the NMJ active zone. Our lab attempts to identify and improve MCell's ability to reproduce the activity of a living NMJ. This project focused on experimental analysis of asynchronous vesicle



release to understand further how vesicle release occurs. We do this by running an MCell model that generates data on vesicle release immediately after an action potential or train of action potentials and comparing it to respective experimental data. We found that MCell does produce experimental data showing asynchronous vesicle release following an action potential. However, the timing of this asynchronous vesicle release is two orders of magnitude faster than expected (decay that occurs quicker than its experimental counterpart). We postulate that this difference between the MCell model and experimental data could be caused by differences in the geometry/energy of synaptotagmin and synaptotagmin-Y, boundaries of diffusion for calcium ions, and/or the buffer molecule occupancy for calcium ions. Future directions of this study could be analyzing these variables in greater detail to reconcile the MCell model with experimental data.

### [7 - Testing to Determine the Effects of Biochar on the Survival of Beneficial Nematodes \(\*Steirmeria carpocapse\*\)](#)

**Samantha Cranford**, *Biology*

Mentor: **Bryan Sales**

Beneficial nematodes, though most invisible to the naked eye, can significantly aid plant growth by killing destructive grubs. Biochar, a porous and carbon-rich material, is being increasingly used as a soil amendment for crop production. Previous research has focused on biochar's ability to kill harmful nematodes due to their crop yield impact. However, the effect that biochar may have on beneficial nematode populations in the world is unknown. A 4-week lab study was conducted to determine the survivability that *S. carpocapse* has when incubated with approximately 10 g of pure wood-derived biochar, biochar + field soil, biochar + mushroom compost, and field soil. Each incubation had low moisture (5 mL), high moisture (10 mL) treatment, and repeated measures of mortality rates were taken every two days across the 4-week experiment. At the end of the 4-weeks experiment, it was determined from the data that the field soil-only combination had the lowest mortality counts. Overall, nematodes tended to have low mortality in low moisture conditions. The biochar-only combination had adverse effects on the survival of nematodes. These effects appeared to be subsided in Petri dishes that had field soil or compost added to them. Further research should be conducted to determine the impact beneficial nematodes have on soil pests in biochar-mended soil. To expand further upon this research, studies can be upscaled into a greenhouse and added to a horticulture system. The plants' health can be monitored alongside the nematode count to see the effects of biochar on a farm environment.

### **8 - Boosting the cellular garbage disposal: enhancing lysosomes can lower amyloid- $\beta$ and alleviate the cognitive decline in a mouse model of Alzheimer's disease.**

**Mercedes Dos Santos**, *Biology*

Mentor: **Ben Bahr**

Alzheimer's disease (AD) is characterized by multi-proteinopathy and progressive synaptic deterioration. The hallmarks of AD are extracellular deposits of amyloid- $\beta^2$  plaques and intraneural neurofibrillary tangles often formed by hyperphosphorylated microtubule-associated protein Tau, occurring in correspondence with inefficient protein clearance, such as age-related lysosomal dysfunction. Here, the aims were to test if boosting the lysosomal pathway can lighten the protein accumulation stress and conserve the cognitive function in the transgenic mice model of AD. Male, 10-12 months-old 3xTg AD Mice, which contain three mutations associated with familial AD and related dementia (APP Swedish, MAPT P301L, and PSEN1 M146V), were treated orally with a compound that enhances the active form of the lysosomal protease cathepsin B (CatB-30). This compound, Z-Phe-Ala-diazomethylketone (PADK), an inactive compound, was administered at 18mg/kg/0.5 day for 11 days. Mice with a wild-type genetic background were used as the control group. Further, each mouse from each group was blindly accessed two days in the open field test to check the exploratory habituation. Following, brain samples were collected and immunostained for the detection of human amyloid- $\beta^2$ . Accordingly, the accessed memory was compromised in 3xTg AD mice compared to wild type group, and the PADK 3xTg AD mice exhibited a preserved memory function. Next, the immunostaining images with specific antibodies for detect human amyloid- $\beta^2$  showed a significant reduction of positive stain in PADK-treated mice. In conclusion, a boost of the lysosomal pathway seems to be a promising avenue to treat early AD pathology.

## [9 - Myrica cerifera, a Medicinal Plant of the Lumbee Tribe, Has Antibacterial and Nematicidal Properties](#)

**Ashley Edwards**, *Biology*

Mentor: **Courtney Alexander**

Currently threatening the world of medicine is a growing number of antibiotic resistant diseases. More specifically, bacteria and nematodes have gained resistance to many of the world's leading antibiotics making infections more difficult to treat. Subsequently, these parasitic organisms can continue damaging crops and other living organisms like humans without strong interference. To help people and the environment, a new strain of antibiotics is vital. Previous research suggests phytochemicals are a potential solution that will help not only inhibit bacterial growth, but also reduce nematode survival. We hypothesized *Myrica cerifera*, a plant often used by the Lumbee tribe to treat illness, possesses antibacterial and nematicidal properties. To answer our hypothesis, we began by collecting plants and performing a chemical extraction to run an NMR. We then tested for antibacterial properties with an agar diffusion assay and nematicidal properties by heat shocking and assaying treated *C. elegans*. The findings of this study show that this plant, more commonly referred to as wax myrtle, does significantly decrease the lifespan of *C. elegans* and the zone of inhibition for *S. epidermidis* and *S. aureus*. We isolated and identified two compounds through chemical extraction, which could potentially be used to treat bacterial and nematode infections.



## 10 - Evaluating the Number of Microplastics in the Lumbee River

**Carlee Epting**, *Biology*

Mentor: **Amber Rock**

Microplastics, debris that are less than five millimeters in length have been a problem in marine and freshwater ecosystems for decades. Microplastics cause harm to the local and native wildlife due to their small size and potential for bioaccumulation. While more is known about the effects of microplastics in marine ecosystems, it is also important to understand the extent of microplastic pollution in freshwater ecosystems. This research aims to evaluate the amount of microplastic pollution in the Lumbee River, an ecologically and economically important river in southeastern North Carolina. Samples were collected at three different sites, strained, and examined under a microscope. Other measurements such as turbidity, pH, and water temperature were also collected. Data collected so far indicated that fibers were the most common type of microplastic present at each sample site. Each sampling date had a different site that contained the highest amount of microplastics. More fibers were found at each site than any other microplastic. More data is needed to truly determine the full effects of microplastics on the Lumbee River.

## 11 -Competitive Insect and Abiotic Condition Effects on Bumblebee Houses

**Autumn Hair**, *Biology*

Mentor: **Kaitlin Campbell**

Bumblebees are very important pollinators, especially since they can fly in colder temperatures than many other bee species. Sadly, the bumblebee population has been declining. In an effort to promote bumblebee conservation, we deployed 60 bumblebee boxes on May 29, 2019. Boxes were placed at varying heights with two different types of openings, hole or pipe at four locations. The boxes also featured iButton temperature probes, which measured the temperature every 4 hours. We hypothesized that Bumblebees prefer to nest in boxes with steady temperatures, low moisture, and that are not colonized by competing organisms. Although no boxes were colonized, the variety in box type and placement allowed us to test for competitors and abiotic conditions. We compared these factors by box opening style, position (tree or ground), and location of the box. We also compared the standard deviations of temperature. The data showed that the most abundant biotic competitor was ants, and they preferred boxes on the ground with a pipe. Wasp competitors preferred hole openings in tree. The RCC and UNCP garden locations had the biggest issues with competitive species while the Locklear farm location had the biggest issue with moisture. The Pine cottage location seemed to be the best location for bumblebee houses due to boxes at this location having the least amount of both competitors and moisture. Future work will continue testing factors influencing these boxes and potential colonization.

## 12 - Nuthatch Territories on UNCP Campus

**Jenna Larkins**, *Biology*

Mentor: **Katherine Thorington**

*Sitta pusilla* (Brown-headed Nuthatch, BHNU) and *Sitta carolinesis* (White-breasted Nuthatch, WBNU) are year-round resident species of climate concern. Documenting territory locations facilitates our understanding of local scale impacts on territory location and density in response to increases in human development and climate change. We split the UNC Pembroke campus into two approximately 17 sites, North (rural) and South (urban). In each, we conducted weekly counts of all identifiable bird species found by following walking routes designed to systematically survey the sites as accurately as possible. While surveying these routes we simultaneously mapped all Nuthatch locations and behaviors. We generated an ArcGIS map and used it to estimate the Nuthatch population density and territory numbers. Our data show that the North site is more densely populated, compared to the South site. This fall, the North campus BHNU observations per visit ranged 0-6 birds (mean 2.3) and WBNU per visit ranged 0-2 birds (mean 0.5), while the South campus BHNU per visit ranged 0-4 (mean 1.6) and WBNU per visit 0-1 (mean 0.1). We found 3 BHNU territories in the North campus site and 2 BHNU territories in South campus site. WBNU were found to have no observed territories in either site for both seasons. This Spring in the North site BHNU observations per visit ranged 0-8 birds (mean 5.3) no WBNU were observed, while the South had a BHNU range of 0-5 observations per visit (mean 1.6) and WBNU observations per visit 0-2 (mean 0.4). So far this spring (Data collection through April 15, 2021), we have found 5 BHNU territories in the North and 1 BHNU territory in the South. We are currently expanding the project to include several off-campus sites for comparison. Data collected this school year provides a baseline for continued work studying Nuthatch demography and space use across the urban-agricultural gradient on campus.

### **\*\*13 - Bee and wasp use of native bee houses at the UNCP Campus Garden and Apiary**

**Macaela Locklear**, *Biology*

Mentor: **Kaitlin Campbell**

Native bees are key pollinators of many native plants and crops. Bees are important for environmental stability, as around 75% of non-agriculture plants rely on pollination. UNC-Pembroke's native bee house project aims to provide housing for native bee species and understand if we are meeting the nesting needs of existing bees in the campus garden. Hundreds of solitary bee species nest in hollow reeds and tubes and may have preferences for different sizes and materials. We set out over 1300 nest tubes in spring and harvested the cocoons for overwintering in the fall over 3 years. There were 100 cocoons (10 species) in 2018, 477 cocoons (12 species) in 2019, and 342 cocoons (9 species) in 2020. Cocoons from 2019 and 2020 showed medium paper-based tubes hosted the largest number of species and abundance of cocoons compared to other sizes of paper, bamboo, or reed tubes. In 2019 all types and sizes of tubes were used between

30-40%, while in 2020, bamboo was used more frequently (74%) than reeds (11%) or paper (22%), and smaller sizes were preferred (46%) over medium (30%) and large (24%). Collections from 2018 and 2019 included bee species, particularly *Osmia*, and wasp species such as *Isodonta*. The data collected in these yearly cocoons censuses can help us improve the bee houses to make them more habitable for the bees. The improvements made in the future will encourage the diversity of native bee species in our area so that the native environment and plants can thrive.

\*\*PURC Supported Scholar. [Presentation can be viewed in the April 26, 2021 live Symposium Recording](#)

#### **14 - Evaluation of an easily fabricated microscale spectroelectrochemical device**

**Tiffany Bramblett Simpson**, *Chemistry and Physics*

Mentor: **Paul Flowers**

There has been an increase in demand for analytical techniques and devices that help examine microscopic amounts of solutions. This technique is an important addition to the development of new devices capable of microscale chemical analysis based on the samples light absorption as it is being electrolyzed. The results so far include exhaustive electrolysis in thin layer behavior. We have the low peak separation and current rises and falls back down to zero and does not decay to a diffusion limit value. In short, all the ferricyanide will convert to ferrocyanide. If successful, the results of our research could facilitate development of improved technologies for spectroelectrochemistry on a microscale level.

#### **15 – Faraday Rotation in Air, Combining Brute Force with Finesse**

**James Graham**, *Chemistry and Physics*

Mentor: **William Brandon**

Because of the weak circular birefringent response of diamagnetic gases to axial magnetic fields, and hence low values of their Verdet constants, only a handful of research groups have successfully measured non-resonant Faraday Rotation in such gases. Here, we report on a straightforward technique resulting in an accurate measurement of the Faraday rotation in air. Our experimental method combines brute force (a magnetic field intensity of around 210 gauss over a 60 cm length), and finesse (differential phase sensitive detection), resulting in the value of  $5.03(3) \times 10^{-6}$  min/G/cm at 639 nm for the Verdet constant of air, which appears to be quite accurate based on all known information.

## 16 - Case Study Analysis of Eigenvector Continuation Method applied to Anharmonic Oscillator

**James Graham**, *Chemistry and Physics*  
**Evert Garcia-Guzman**, *Chemistry and Physics*  
Mentor: **Thomas Dooling**

A thorough analysis is done comparing the results of the novel Eigenvector Continuation (EC) method with those of the well-studied Finite Difference (FD) method for different values of  $\lambda$ ; with an additional focus on how well EC approximations hold for higher energies and values of  $\lambda$ . Various metrics, such as the spacing and placement of sample points and the size of the sample size are analyzed in order to study the effects that they have on the accuracy of EC.

## 17 - A Study of Small Oscillation Theory for Three Different Forces

**Stenson Sampson**, *Chemistry and Physics*  
Mentor: **Thomas Dooling**

A study was conducted on the use of the theory of small oscillations for three different types of forces acting on a double mass system. A linear spring force, a non-linear spring force and a double pendulum. Data was recorded for mass positions as a function of time, and frequencies of oscillation. Python (version 3.9) was used for conducting this experiment with using Runge-Kotta for computing the solutions to the differential equations that were encountered. Small oscillation frequencies were compared with measured frequencies of different ranges of initial displacement.

## 18 - Estimating Groundwater Recharge Using Streamflow Data within a Section of Southeastern North Carolina

**Abigail Canela**, *Geology and Geography*  
Mentor: **Madan Maharjan**

Groundwater and surface water interactions play a vital role in the functioning of riparian ecosystems. These interactions occur in two ways: streams gain water from the inflow of groundwater through the streambed (gaining stream), and stream water infiltrates through the sediments into the groundwater (losing stream). Precipitation is the main source for groundwater recharge. Seasonal variations in precipitation patterns and single precipitation events can induce changes in the direction of exchange flows. However, this relationship between aquifers and surface waters recently became a subject of research interest. In this project, two methods are explored to investigate this balance between groundwater recharge and streamflow and investigate the effect precipitation has on groundwater recharge. Streamflow from five stream sites within southeastern NC was analyzed using RECESS and RORA methods. Master recession curves were determined using the RECESS program, and recharge estimation was completed using the

recession-curve-displacement through the RORA program. To assess the effect precipitation has on recharge, monthly average recharge was determined and compared with monthly average precipitation. Correlation testing shows that precipitation has an insignificant effect on groundwater recharge. While all sites exhibited slight temporal variation, they all had significant spatial variation. Other parameters must be explored to determine better predictors for groundwater recharge and clarify variations observed across all sites.

## 19- Synoptic Meteorology of Hurricanes

**Joeseeph Capstaff**, *Geology and Geography*

Mentor: **Dennis Edgell**

During my Studies on Hurricane Synoptics, I studied the variety of ways the Hurricanes form. Hurricanes may also develop to become stronger due to the increasing temperatures from climate change, causing the slowdown of overall hurricanes, and more catastrophic damage that can be done by them. The way climate change is able to affect hurricanes is through the warming of the ocean, through the carbon cycle, allowing for much warmer waters to occur. As the temperature gradients move from high to low, we can also see hurricanes follow these tracks as they move around areas of high pressure and could send these hurricanes either into the Gulf of Mexico, or up into the east coast. We are also able to compare the models used with European models and American models, with the European models being far more accurate when it comes to forecasting hurricanes. We may also see La Nina having an effect on Hurricanes, as they affect the wind shear in the Atlantic Ocean Basin, allowing the hurricanes to become much stronger and slower, relating to the amount of damage that they can make. In other terms of said temperature gradients, we also rely on the Bermuda High to tell us the tracks that the hurricanes may take.

## 20 - Are Hurricanes in the Southeastern United States Getting Worse?

**Arturo Carmona**, *Geology and Geography*

Mentor: **Dennis Edgell**

Natural disasters like hurricanes are and will always be a reoccurring problem for the land that we as a nation occupy, along with other countries who neighbor us, and to the animal/plant population we share our space with. Tropical storms like hurricanes, have been always been around with the first one being recorded back in 1939 and probably more years prior to its first documentation, but back then hurricanes from those earlier years were less frequent and while still violent in storm strength, does not come even close to the ferocious nature they are known for today. However, as the human population continues to increase and people begin expanding outwards towards the shorelines of our nation; hurricanes start to become an even bigger issue than it was before. Moreover, if the situation was not already fragile enough, with the increase of population around the globe so does the increase of climate change that affects the condition of atmosphere. A factor that has been known to increase the intensity and power of these tropical storms

creating a superior version of these already violent storms. A factor I know will be a problem for the geography of this nation and the people who inhabit it. In addition, in order to gain the knowledge that is required to gain a grasp of this situation at hand will come from the understanding of how a hurricane is structured with the utilization and generating of heat energy and understand how much climate change affects the destructive nature of these super storms. Detailing the amount of rainfall that will pour over the land, how much wind speeds will increase and how much more flooding will occur inland.

## 21 - A Study of Underground Coal Mine Fires

**Jason Free**, *Geology and Geography*

Mentor: **Dennis Edgell**

The coal industry is a staple of the American power grid. Usage peaked in 2008 and slowly declined as we developed and utilized other various forms of energy such as wind and solar. As the need for coal diminished, their mines were abandoned. Since the mines were not properly dealt with before they were abandoned, they have hazardous effects on the surrounding area with a high lethality for spontaneous combustion. Because these fires take place underground and there is no hope for precipitation to contain the problem, the only real mitigation efforts that can be applied to this problem are fire suppression systems and fire-resistant materials inside the mine. Throughout this study I will inform and educate about the variables that cause underground coal fires and how we can best combat the problem going forward.

## **22 - Understanding aquifer characteristics: A pathway to sustainable development of water supplies**

**Cody Gless**, *Geology and Geography*

Mentor: **Maden Maharjan**

In this study, the hydraulic conductivity of the village well samples was analyzed. Samples were collected and the hydraulic conductivity was measured. The hydraulic conductivity is used to determine the ease with which a substance (e.g. water) will flow through soil.

## 23 - Offshore Wind Farms

**Rebekah Harvey**, *Geology and Geography*

Mentor: **Dennis Edgell**

Renewable energy has become the new trend when it comes to energy resources. Many companies are stepping away from energy sources such as coal, oil and fossil fuels due to the harmful pollutants that they give off. North Carolina is part of the east coast and has offshore wind farms, which have been very beneficial thus far when it comes to renewable energy. Many coastal states have started to use offshore wind farms as a form



of renewable energy because of its many benefits such as stronger wind currents, consistency and the protection of marine ecosystems. However, offshore wind farms are 2.6 times more expensive than onshore wind farms; the long-term benefits are more effective.

## [24 - The Laurentide Glacier and the Maine Landscape](#)

**Stephen Murdoch**, *Geology and Geography*

Mentor: **Dennis Edgell**

The Laurentide Ice sheet is responsible for many of the landscape features found across the state of Maine. The ice sheet has existed for nearly 2.5 million years and has varied in size many times over that time period. The most recent time was 35,000 years ago and it entirely covered what is now New England. The subsequent years warmed and as the glacier retreated, it left behind thousands of signs of retreat. This includes glacier erratics, moraines, eskers, and glacial abrasion. All of these features can be found throughout the state. Daggett's rock in Philips, Me is an example of this process. The boulder's parent rock is 20 miles to the northwest, and the boulder is estimated to weigh 8,000 tons, it was picked up and deposited by the glacier. Many of Maine's mountains are granite bedrock with extensive scarring from sediments being dragged across them. These scars are all aligned in roughly the same cardinal direction. Maine's coast is characterized by its rocky and abrupt features. These too are the result of glacial retreat. As the glaciers melted, the mass no longer weighed down on the continental crust. The resulting loss of mass meant that the coastline rose above the sea-level in response. Weathering has not had enough time to erode the coastline, and as a result, we have the rocky coasts we observe today. The glacial process found in Maine is not unique to the Northeast; the Laurentide Ice Sheet once covered nearly all Northern North America. Viewers of this poster may begin to identify signs of glacier retreat in their parts of the world. However, the Laurentide Glacier has an immense impact on the Maine landscape, creating the coast and the mountains.

## [25 - Yellowstone National Park: Education through ArcGIS Web Maps](#)

**Max Robinson**, *Geology and Geography*

Mentor: **Dennis Edgell**

Yellowstone National Park is home to a vast number of natural history and geologic features. It was the first national park to be recognized by the government. This project was undertaken to educate about the history and cool features of this park using ArcGIS online web maps. Using ArcGIS two maps were created online, a tourist and geologic map. Web maps make useful tools in combining spatial data with education because of their large ability to be interactive and the ability to present multiple data sources.

## 26 - Great Lakes Ice and Icebreakers: Issues in a Changing Environment

**Daniel Moorhead**, *History*

Mentor: **Dennis Edgell**

The U.S. Coast Guard monitors, and contends with, ice along North American waterfronts, including the Great Lakes, yet as of recent years, their larger vessels are far past their operational limits in terms of age, sub-par performance, and are unable to be as efficient as other countries' icebreakers. This leads to difficulties in clearing paths for shipping lanes during the winter months. The proposal to reform the ships and equipment to provide adequate icebreaking in the Great Lakes has been reviewed as to ensure the coastline and shipping remains safe and secure as water levels rise, and ice fields expand further inland. While sea levels rise in the oceans, this adversely affects the water levels in the great lakes due in part to the increase of rain in the region, but in the winter months, the water freezes over and heavy ice fields are formed, pushing against the coastline, and causing damage to harbors, ports, and other ships. Preferably, with modern icebreakers, the Coast Guard would be able to break up heavy ice, allowing for ice to be less thick and less likely to harm coastal areas. Unfortunately, with a decrease in time and resources towards the smallest branch of the military, reserves and supplies are average and not equivalent to the standard that modern standards require, as well as shortages in parts, and repairs continue to afflict the equipment, cutting into the abject budget. Were this to be changed, damages to coastlines would be reduced, more efficient and swifter techniques and equipment would be possible for the Coast Guard, in both the bays and in deep water shipping lanes.

## 27 – Impact of the COVID-19 Pandemic on Job Responsibilities of Athletic Trainers

**Hannah M. Lee**, *Kinesiology*

Mentors: **Susan Edkins and Beverly Justice**

COVID-19 has significantly affected healthcare providers, such as athletic trainers (ATs), since its onset one year ago. Throughout the pandemic, ATs have worked on the frontlines of health care services, yet there are still those that fail to see the value of ATs. This purpose of this study was to determine how the pandemic impacted AT's job status, settings, and responsibilities one year into the pandemic. Participants were recruited through social media to participate in a 14-question online survey that included demographics, Likert scale, and open-ended questions. 50% of participants that remained in their pre-COVID setting were forced to adjust to additional or different job responsibilities brought on by the pandemic, while the other 50% were forced to seek new or additional employment due to having experienced unpaid furlough, reduced work hours/time, or being laid off. These ATs reported transitioning to work in COVID clinics, hospitals/ERs, and wherever they were needed. Some ATs expressed serious concern for themselves mentally while still reporting feelings of appreciation of some of the effects of the pandemic. Despite mental/physical exhaustion, burnout, and uncertainty, most ATs



in this study adapted well and were willing to adjust as needed to meet the needs of their patients. While playing a key role in the pandemic response, either by performing additional responsibilities required of them or by utilizing their skills in other or additional settings, ATs have maintained perseverance and will continue to do so.

## **28 – Barrier Coverage Construction without Barrier Breach in Wireless Sensor Networks**

**Luke Fleming**, *Mathematics and Computer Science*

Mentor: **Joong-Lyul Lee**

In wireless sensor networks, the barrier coverage detects objects crossing a protected area or monitors an area of interest. It is an important application in the wireless sensor networks. In such a wireless sensor network application, sensor nodes are randomly deployed along the boundary of the monitoring area due to cost issues and construct multiple barrier coverage in order to maximize the network lifetime. These multiple barriers are operated according to the sleep-wakeup schedule. In this application, a new security problem, which is the barrier breach problem, occurs in the sleep-wakeup schedule. In this work, we propose a new barrier coverage construction algorithm without barrier breach.

## **29 - Altitude Acclimation**

**Brionna Wright**, *Nursing*

Mentor: **Dennis Edgell**

When people participate in physical activities at high altitude, they typically become tired and short of breath. Headaches and nausea are also symptomatic at elevations above 3000 meters (10,000 feet). The purpose of this presentation is to increase awareness of the most common high-altitude maladies -- Acute Mountain Sickness (AMS) and High-Altitude Pulmonary Edema. These illnesses are caused by breathing air with roughly 30 percent less oxygen than at sea level. At these altitudes, our bodies try to compensate for oxygen deficiency by breathing more deeply and increasing the heart rate, thereby pumping more blood into the body's tissues. The additional blood is thought to cause the brain tissues to swell, resulting in headaches, insomnia, and nausea. Excess alcohol makes the symptoms worse. The conclusions drawn in this research stresses the importance of acclimation. High-Altitude Pulmonary Edema is a buildup of fluid in the lungs that requires prompt medical attention. This project suggests the importance of proper acclimation. Acclimation strategies include getting adequate sleep, elevating slowly, staying hydrated, and eating carbohydrates. Mountain sickness usually can be alleviated with overnight rest at a lower altitude. An adjustment can also be made by sleeping overnight at increasing higher elevations, until one's body adjusts to each level. Some people require supplemental oxygen as their bodies adjust.

### **30 – Atlantic Coast Pipeline Project Reveals Invisibility of Indigenous People**

**Susan Wilson**, *Social Work*

Mentor: **Tamara Savage**

The University of North Carolina at Pembroke in Robeson County is uniquely situated physically and socially in the middle of the Atlantic Coast Pipeline project (ACP). The inhabitants of Robeson County and specifically in the towns of Pembroke and Lumberton attend the University, shop its local establishments, attend its local churches, work, and enjoy leisure activities; yet were unaware of the mounting issue. This undergraduate social work student was tasked with researching the ACP from the social perspective, while collaborating with the undergraduate biology groups researching from the science perspective. Since there were no cultural impact studies done for the ACP (R. Emmanuel, personal communication, 2020) this student chose the research lens of environmental justice and historical oppression. The overall goal of this project was to promote awareness for the ACP and to close gaps in the research and literature on this topic. The invisibility, racism, perversion of land rights, and struggle for tribal survival is perpetuating a strong oppression of the Native American people rooted in historical contexts and contemporary depictions. While the literature is quick to point out these connections, little research exists to formally address or combat the problem.

### **31- A Comparison of On and Off Campus Sexual Violence and Stalking**

**Mya Sampson**, *Sociology and Criminal Justice*

Mentor: **Calvina Ellerby**

This study compares the rates of on and off campus sexual violence. It was expected that the rates of on and off campus sexual violence and stalking would be the same. The study found that rates of sexual violence and stalking are significantly higher on campus than off campus, despite being in the same geographical area, therefore disproving the hypothesis and supporting previous research.

### **32 - Locating the Location of Reserve of The Eightkiller**

**Johanna Reis**, *(not disclosed)*

Mentor: **Dennis Edgell**

Records of the 640 acre reserve granted to the Cherokee known as The Eight killer through the 1817-1819 Treaty with the USA were apparently destroyed in a fire. Using the descriptions of reserves recorded in the Archives of the Tennessee Indian Agency and applying those descriptions to known maps of recorded nearby reserves that have been preserved, we are able to compare to records and maps and confidently determine the location of the reserve that was assigned to a Cherokee native known as The Eight Killer. This project examines what materials are available to help with the identification

of the landmarks necessary to determine the location of the detailed description of the boundaries of the reserve as recorded in the Tennessee state archives.

### **33- A Survey of Environmental Attitudes and Knowledge of University Undergraduate Students for the Purpose of Faculty Development in Teaching and Learning for Sustainability**

**Olivia Sadler,**  
Mentor: **Scott Hicks**

Because today's students will confront global climate change and its concomitant social and cultural disruption, it is vital that they graduate with ecological knowledge, environmental ethics, and civic skills commensurate to these challenges. This study randomly selected 180 undergraduate students enrolled at a highly diverse, socioeconomically disadvantaged historically minority-serving institution to complete the NEP-R and NEETF/Roper 2000 surveys of environmental attitudes and knowledge. This study finds incomplete environmental knowledge and moderate to somewhat negative explicit environmental attitudes. This study will inform the researcher's effort to develop, implement, and assess university-level class- and course-based interventions that seek to improve environmental knowledge and foster positive environmental explicit attitudes.

## THREE MINUTE LIGHTNING TALKS

### [3MT – 1- The effects of a positive lysosomal modulator in neurodegeneration-related X protein accumulation models of Alzheimer-type and Parkinson's-type pathology](#)

#### [Poster also submitted](#)

**Sidney Clayman**, *Biology*

Mentors: **Ben Bahr**

As aging occurs, the removal of old and damaged proteins decreases, leading to protein accumulation in the brain. This protein accumulation causes synaptic pathways to become compromised. Therefore, it leads to neurodegenerative disorders such as Alzheimer's disease (AD) and Parkinson's disease (PD). Here, the aim was to investigate if the lysosomal protein clearance pathway's positive modulation can alleviate protein accumulation stress-induced synaptic pathology in the brain. Rat hippocampal slice cultures, which provide hippocampal native neuronal organization, were treated with Z-Phe-Ala-diazomethylketone (PADK), an enhancer of the active form of lysosomal cathepsin B (CatB). Next, the brain explants were harvested and accessed for the immunoreactive levels of autophagy-lysosomal components and synaptic proteins. Accordingly, application of the positive lysosomal protease enhancer resulted in an increase of active form of cathepsin B in the brain explants, and associated with the CatB modulation was the enhancement of synaptic markers and SIRT1. Also, the resulting enhanced proteolytic activity of CatB was demonstrated by testing for the cleavage product of the CatB substrate DAB2. Next, when a group of cultured brain slices insulted with the lysosomal inhibitor chloroquine (mimics age-related protein accumulation stress), the PADK treatment was found to increase the amount of CatB. In conclusion, the positive modulation of a lysosomal protease shows a potential therapeutic avenue against age-related protein accumulation stress.

### [3MT – 2 - Exercise mimetic augments autophagy-lysosomal protein clearance and provides protection against protein accumulation-induced synaptopathology](#)

**Minh Huy Giang**, *Chemistry and Physics*

Mentor: **Ben Bahr**

Brain aging gradually leads to synaptic and cellular vulnerabilities, influencing cognitive function and risk for dementia. Health-improving exercise is strongly linked to the slowing of cognitive decline and perhaps reducing the risk of age-related proteinopathies such as

Alzheimer's Disease (AD) (Sohn 2018). AD and the prior condition of mild cognitive impairment have been suggested to involve compromised levels of the autophagy-lysosomal protein clearance (Hwang et al. 2019). However, the exercise mechanisms that protect and improve synaptic integrity and promote brain health remain incompletely elucidated. Here, Î²-guanidinopropionic acid (Î²-GPA), known as an exercise mimetic inducing the autophagy-lysosomal process, was examined in cultured brain tissue for changes in synaptopathies linked to age-related protein accumulation stress. Accordingly, 1 mM Î²-GPA was applied to rat hippocampal slice cultures daily for 3-9 days, followed by an assessment for changes in pre- and postsynaptic protein levels and components of the autophagy-lysosomal pathway such as cathepsin B (CatB), a lysosomal protease, as compared to vehicle. Next, the slice cultures were pre-treated with Î²-GPA for 3 days then were insulted with the lysosomal inhibitor chloroquine (60 ÂµM CQN) and tested against protein accumulation-induced synaptic compromise. Results show that Î²-GPA treated explants exhibit a time-dependent enhancement of the active form of CatB without disrupting synaptic integrity. While in CQN-treated model, Î²-GPA prevents synaptic disruption. In summary, exercise mimetics show effectiveness in promoting brain health through protein clearance activation linked with synaptic protection.

### [3MT – 3 – Positive Modulation of a Lysosomal Protease Leads to Dual Modulation of Distinct Protein Clearance Systems and Results in Synaptic Protection in a Brain Explant Model of Protein Accumulation Stress](#)

**Jessalyn Nguyen**, (*Biology*)

Mentor: **Ben Bahr**

Enhancing the activity of the cysteine protease cathepsin B (CatB) has been observed to be an effective strategy to ameliorate Alzheimer-type protein accumulation pathology and the associated synaptopathy. While it has been reported that few autophagy inducers reliably activate autophagy for cellular protection, distinct positive modulators of the autophagy-lysosomal pathway facilitate the maturation and fusion process with lysosomes to promote autophagic cargo delivery to lysosomes for protein clearance. Such positive modulators, e.g. the peptidyl compound Z-Phe-Ala-diazamethylketone (PADK), the non-peptidyl SD1002, E64d, and UP1A-101, increase the levels of active CatB in such a way that promotes clearance of multiple types of pathogenic proteins and improves cognition and synaptic integrity (Butler et al. 2011 PLoS One 6:e20501; Farizatto et al. 2017 PLoS One 12:e0182895; Hwang et al. 2019 Internatl J Mol Sci 20:4432). The PADK and E64d compounds are very weak inhibitors of the A $\beta$ -degrading CatB, but they both were found to up-regulate CatB levels in a compensatory manner which may explain their beneficial actions in AD mouse models. The results indicate a strong correlation between CatB-30 and enhanced levels of both SIRT1 and beclin-1, noting that these biomarkers have crucial roles in initiating autophagy and facilitating autophagosome formation. Interestingly, PADK also enhanced the LC3I to LC3II conversion in the hippocampal slice model. Furthermore, enhancement of CatB by PADK was not permanent, but reversible. At high concentrations, PADK is a modest CatB and

cathepsin L (CatL) inhibitor. A more potent inhibitor, CA074, does not influence CatB activation. The findings in this study could lead to the development of more effective positive lysosomal modulators for treating protein accumulation disorders.

### **3MT – 4 - Constructing Gene Models on the contig50 Project from the *D. bipectinata* Muller F Element**

**Ashton Tillett**, *Chemistry and Physics*

Mentor: **Maria Santestiban**

The last twenty years have allowed for a massive increase in the number of computationally derived genome assemblies for a variety of organisms. The Genome Education Partnership (GEP) has developed software capable of annotating genes in those already sequenced genomes. The fourth and smallest chromosome of *D. melanogaster* known as the Muller F element is packaged as heterochromatin, thus theoretically indicating that it should not be capable of transcription and translation. However, there are approximately 80 genes that code for specific proteins in this chromosome. Surprisingly, these F element genes exhibit expression levels like those of euchromatic genes. This suggests they have amassed exclusive features that bolster their functionality independent of their heterochromatic nature. This project examined, through the annotation of the coding regions, the evolutionary significance of variation in chromosome size and the identification of components that facilitate the functionality of heterochromatic genes in *D. bipectinata* contig50 relative to *D. melanogaster* genes. Investigation of the contig50 project illustrated that there is at least one putative ortholog in *D. melanogaster*. This ortholog is denoted as dpr7-RG. It is by examining the amino acids in each frame of the contig50 sequence and other indicative features such as the phases, exon-intron boundaries, RNA-Seq data, etc., that the definite coordinates for each CDS of dpr7-RG and other orthologs were determined.

### **3MT – 5 - Evidence of Organophosphate-Mediated Synaptopathology is Governed by Neuron-Specific $\beta$ 1 Integrin Responses**

**Jared Tuton**, (*not disclosed*)

Mentor: **Ben Bahr and Karen Farizatto**

Organophosphates (OP), a deadly class of poisons which inhibit acetylcholinesterase inducing cholinergic crises that may lead to seizure events and death, while survivors commonly experience long-term neurological problems. OP are still a widely used agricultural pesticide and a toxin used during warfare atrocities deployed by terrorist groups as well as state actors. Therefore, understanding the distinct synaptotoxic profile exhibited by organophosphates is a public health imperative. The administration of the organophosphate paraoxon (PXN) exhibited distinct synaptopathology in brain tissue, in vivo and in vitro (Farizatto et al. 2017 *J Mol Neurosci* 63:115–122; Farizatto et al. 2019 *Sci Rep.* 9(1):6532). Here, mature rat hippocampal slice cultures were acutely exposed to 200  $\mu$ m of PXN, with or without BIO 5192 ( $\beta$ 1-integrin inhibitor), and the synaptic events were assessed by immunoblot for the synaptic markers, synaptophysin and synapsin II

isoforms. Our results showed that Pxn mediated synaptic decline accompanied by abnormal induction of  $\beta$ 1-integrin adhesion responses, a synaptic adhesion receptor that regulates synaptic maintenance. The synaptotoxic profiles were evident in the dendritic zones of the CA1, CA3, and dentate subfields. Interestingly, the synaptic compromise observed in PXN-exposed explants was not exhibited after the application of the inhibitor Bio5192, suggesting that blocking  $\beta$ 1 integrin signaling appears to attenuate the unique synaptotoxicity mediated by PXN associated with selective integrin dynamics. The implication of this study is the therapeutic role of integrin modulation leading to preserving synaptic integrity. However, more data is needed to understand the specific relationship between synaptotoxic events and compensatory adhesion responses.

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